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DEVELOPMENT AND ANATOMY OF THE PROSTATE GLAND

W. G. RICHARDSON

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THE PROSTATE GLAND

The Heath Scholarship Prize Essay

ON

THE DEVELOPMENT AND ANATOMY
OF
THE PROSTATE GLAND

TOGETHER WITH AN ACCOUNT OF

ITS INJURIES AND DISEASES
AND THEIR
SURGICAL TREATMENT

BY

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LONDON
J. & A. CHURCHILL
7 GREAT MARLBOROUGH STREET
1904

4581

PRINTED BY
SPOTTISWOODE AND CO. LTD., NEW-STREET SQUARE
LONDON

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PREFACE

THE late George Yeoman Heath, M.D., M.B., D.C.L., F.R.C.S., Professor of Surgery in the University of Durham, and President of the University of Durham College of Medicine, bequeathed the sum of 4,000*l.* to found a scholarship in surgery, the interest to be awarded every second year.

All graduates in Medicine or in Surgery of the University of Durham are eligible to compete for this Scholarship.

In March 1902 the Trustees of the Heath Scholarship selected as the subject of the essay for 1904 'The Development and Anatomy of the Prostate Gland, together with an account of its injuries and diseases and their surgical treatment.'

On the recommendation of the Professor of Surgery (Mr. Frederick Page) the Council of the College of Medicine awarded the prize to my essay.

Although the allotted subject included an account of the injuries as well as the diseases of the prostate, I have made no mention of them. Uncomplicated injuries are very rare, and I have had no opportunity to observe any such case. Other diseases than that which is known as Chronic Enlargement or Hypertrophy have been dealt with in a very cursory manner. Chronic enlargement being the most important and commonest affection of the organ, it overshadows all other diseases of the prostate.

The essay was written with care not to reveal the identity of the author, and this prevented me from disclosing the names of the surgeons to whom I am indebted for the histories of seventeen of the cases and for many of the specimens. I should like to take this opportunity to thank Dr. Hume, Mr. Rutherford

Morison, Mr. Ridley, and Mr. Martin, who not only placed the histories of their patients at my disposal, but also allowed me to take the specimens which they removed during operations upon the prostate. To Mr. John Clay and Mr. G. Gray Turner, the surgical registrars at our Infirmary, I must also acknowledge my indebtedness for the notes of many of the cases.

The Council of the College of Medicine have very generously made me an additional grant of 25*l.* to be devoted to reproducing the drawings and have granted me permission to publish the essay.

It will be noticed that no references are made to the sources of information. I should like to have made good such an omission, but to do so would involve going over the whole work again. This is only an essay, and it makes no pretension to be a treatise on the subject of the prostate. I therefore publish it exactly as it was submitted.

The specimens and drawings which accompanied the essay are now in the museum of the College of Medicine. The drawings were all made by me from the specimens, with the exceptions of numbers 31, 32, and 33, which I copied from Owen's 'Comparative Anatomy,' and number 34, which I copied from the 'Journal of Anatomy and Physiology,' April 1901. I wish to thank Dr. Berry Hart for his kind permission to reproduce this illustration.

W. G. R.

June 1904.

LIST OF SPECIMENS

A. ANATOMY.

1. Normal Adult Prostate.
2. Normal Adult Prostate, with Vasa Deferentia and Vesiculæ Seminales.
3. Accessory Organs of Generation, showing Prostate, Vasa Deferentia, Vesiculæ Seminales, and Cowper's Glands.
4. Bladder, Prostate, and Urethra, in coronal section viewed from the front.
   Vesiculæ Seminales, Vasa Deferentia, Ejaculatory Ducts, and Prostatic Utricle, viewed from behind.
5. Same as No. 4.
6. Sagittal Section of Adult Pelvis in middle line.
7. Sagittal Section of Adult Pelvis ⅓ inch to the left of middle line.
8. Sagittal Section of Adult Pelvis ⅔ inch to the left of middle line.
9. Coronal Section of Adult Pelvis immediately behind the Symphysis Pubis, viewed from behind.
10. Coronal Section of Adult Pelvis immediately in front of Prostate, viewed from behind.
11. Coronal Section of Adult Pelvis through Prostatic Urethra, viewed from behind.
12. Coronal Section of Adult Pelvis behind Urethra, viewed from behind.
13. Sagittal Section of Pelvis of Full-term Fœtus.

B. COMPARATIVE ANATOMY

14. Genitalia of Australian Opossum.
15. Genitalia of American Opossum.
16. Genitalia of Small American Opossum.
17. Genitalia of Squirrel.
18. Genitalia of Guinea-pig.
19. Genitalia of Guinea-pig.
20. Genitalia of Rabbit.
21. Genitalia of Hedgehog, in February.
22. Genitalia of Mole.
23. Bladder and Prostate of Dog.
24. Genitalia of Civet Cat.
25. Genitalia of Large Black Ape.
26. Genitalia of Large Black Ape.
27. Hypertrophied Bladder and Enlarged Prostate of dog
28. Bladder and Prostate of Dog, with Vesical Calculus.

C. PATHOLOGY

29. Enlarged Middle Lobe of Prostate.
30. Sacculated Bladder from same case as specimen 29.
31. Enlarged Prostate, sacculated inflamed Bladder, dilated Ureters, and Pelves of Kidneys.

32. Enlarged Prostate, sacculated inflamed Bladder, dilated Ureters, and Pelvis of Right Kidney (case 35).

32 A. Enlarged Prostate, sacculated inflamed Bladder, acute septic nephritis.

33. Enlarged Prostate, hypertrophied Bladder, dilated Ureters, and Abscess at Back of Prostate.

34. Acute Prostatitis with Prostatic Abscess (see page 107).

35. Bladder and Prostate after suprapubic Prostatectomy, showing the bed from which adenomata were removed (case 30).

36. Bladder and Prostate after suprapubic Prostatectomy, showing the bed from which adenomata were removed, and a tear through the capsule into the sheath with consequent laceration of veins, from which the patient died of hæmorrhage (case 22).

37. Enlarged Prostate, sacculated inflamed Bladder, dilated Ureters, and Pelves of Kidneys, also adherent Capsule and diminished Cortex of Kidneys (case 36).

38. Sarcoma of Prostate (see page 110).

39. Kidney with acute septic Nephritis.

Specimens removed by Operations.

Total suprapubic Prostatectomy.

40. Complete Prostate with its capsule and its sheath and pieces of levator ani (from case 6).

Adenomata in one mass, from suprapubic Prostatectomy.

41. From case 8.
42. „ „ 2.
43. „ „ 11.
44. From case 4.
45. „ „ 1.

Adenomata in separate masses.

By suprapubic route.

46. From case 20.
47. „ „ 29.
48. „ „ 27.
49. „ „ 17.
50. „ „ 7.
51. From case 3.
52. „ „ 5.
53. „ „ 30.
54. „ „ 33.
55. „ „ 25.

By perineal route.

56. From case 24.
57. From case 12.

Middle lobe only.

58. From case 31.

Carcinoma.

59. From case of suprapubic Prostatectomy of which the notes have been mislaid.

D. Microscope Slides.

Anatomy.

60. Sagittal Section of Prostate in middle line, showing outlet of Bladder, Prostatic Utricle, common Ejaculatory Duct, Rectum and Cowper's Gland. Subject aged 18 years.

61. Same as No. 60, immediately to one side of the Urethra. From the same subject as No. 60.

62. Coronal Section of entire Prostate immediately behind the Urethra. Subject aged 24 years.
63. Transverse Horizontal Section of entire Prostate close to the Bladder. Subject aged 22 years.
64. Transverse Horizontal Section of entire Prostate through terminal part of prostatic Utricle. Subject aged 32 years.
65. Transverse Horizontal Section of Urethra at the Apex of the Prostate. Subject aged 18 years.

Development.

66. Transverse Horizontal Section of Urethra, showing two Prostate Glands, at 3½ months.
67. Transverse Horizontal Section of Urethra, showing Prostate Glands at 9 months

E. CALCULI.

68. Removed from case 7.
69. " " " 33.
70. Removed from case 27.

ILLUSTRATIONS

1. Normal Adult Human Prostate (from specimen 1).
2. Normal Adult Human Prostate with Vasa Deferentia and Vesiculæ Seminales, viewed from above (from specimen 2).
3. Transverse Section through middle of Human Prostate, slightly magnified, showing Capsule, Stroma, Anterior Commissure, Arrangement of Gland Tissue in Lobules, Common Ejaculatory Ducts and Utricle (from micro-specimen 64).
4. Transverse Section of Human Prostate close to Bladder, slightly magnified, showing Capsule, Stroma, Sheath, Anterior Commissure, Lobules of Lateral Lobes, separate Lobules of Middle Lobe focussing on back of Urethra, and the Ejaculatory Ducts (from micro-specimen 63).
5. Coronal Section of Human Prostate behind Urethra, slightly magnified, showing Sheath, Capsule, Stroma, Lobules of Lateral Lobes, separate Lobules of Middle Lobes, and the Ejaculatory Ducts (from micro-specimen 62).
6. Microscopic Section of Human Prostate, showing Stroma, Basement Membrane, and Arrangement of Gland Epithelium. Tubules mostly in longitudinal section (from micro-specimen 64).
7. Tubule of Human Prostate cut in Transverse Section, showing Connective Tissue, Basement Membrane, and Arrangement of Gland Epithelium (from micro-specimen 64).
8. Coronal Section of Bladder, Prostate, and Urethra (from specimen 4).

8 A. Posterior view of Bladder, Prostate, Seminal Vesicles, Vasa Deferentia, Common Ejaculatory Ducts, and Prostatic Utricle (from specimen 4).

9. Sagittal Section of Human Prostate in Middle Line, slightly magnified, showing Urethra, Outlet of Bladder, Rectum, Prostatic Utricle, Common Ejaculatory Duct, Middle Lobe, and Cowper's Gland (from micro-specimen 60).
10. Transverse Section of Human Urethra at Apex of Prostate, slightly magnified (from micro-specimen 65).
11. Sagittal Section of Human Prostate at side of Urethra, slightly magnified, showing Continuity of Muscular Wall of Bladder with that of Urethra (from micro-specimen 61).
12. Microscopic Section of portion of Seminal Vesicle (from micro-specimen 60).
13. Microscopic Section of Cowper's Gland (from micro-specimen 60).
14. Sagittal Section of Adult Human Male Pelvis in middle line (from specimen 6).
15. Sagittal Section of Adult Human Male Pelvis, ⅛ inch to left of middle line (from specimen 7).
16. Sagittal Section of Adult Human Male Pelvis, ⅜ inch to left of middle line (from specimen 8).
17. Coronal Section of Human Adult Male Pelvis through Prostatic Urethra, viewed from behind (from specimen 11).
18. Coronal Section of Human Adult Male Pelvis immmediately in front of Prostate, viewed from behind (from specimen 10).

19. Coronal Section of Human Adult Male Pelvis at posterior edge of Symphysis Pubis (from specimen 9).
20. Side View of Bladder and Prostate, showing Recto-Vesical Fascia.
21. Back View of Symphysis Pubis with Bladder pulled to right, showing Fasciæ and Pubo-prostatic Ligaments and Lateral True Ligaments of the Bladder.
22. Bladder, Prostate, Vasa, and Seminal Vesicles, viewed from below, showing Peritoneum and Vesical and Rectal Fasciæ.
22 A. Sagittal Section of Full Term Fœtus (specimen 13).
23. Genitalia of Australian Opossum (specimen 14).
24. Genitalia of Small American Opossum (specimen 16).
25. Genitalia of Squirrel, showing small size of Seminal Vesicles and great size of Cowper's Glands (specimen 17).
26. Genitalia of Guinea-pig, showing great size of Seminal Vesicles and relatively small size of Cowper's Glands (specimen 19).
27. Genitalia of Mole in April (specimen 22).
28. Genitalia of Hedgehog in February (specimen 21).
29. Genitalia of Civet Cat, showing absence of Seminal Vesicles and large size of Cowper's Gland (specimen 24).
30. Genitalia of Large Black Ape, showing the Likeness to Human Organs (specimen 25)
31. Genitalia of Beaver (Owen).
32. Double Utriculus Masculinus, and terminations of Seminal Vesicles, of Beaver (Owen).
33. Genitalia of Goat, showing Utriculus Masculinus continued by Cornua as far as Epididymis and widely separated from the Prostates (Owen).
34. Dorsal View of 2 mm. Human Embryo, $\frac{14}{1}$; P.S., Primitive streak; N.T., Neurenteric canal entering yolk-sac; N.G., Neural groove; H.P., Head end of embryo (Graf Spee). (After Dr. D. Berry Hart; 'Journal of Anatomy and Physiology,' April, 1901.)
36. Diagram to illustrate manner in which the Ureter, Vas Deferens, and the Bladder arise in the Embryo. C.M., Cloacal membrane; E.C., Ectodermal cloaca; E.N., Entodermal cloaca; Al., Allantois; U., Ureter; W., Wolffian duct; S., Seminal vesicle; B., Bladder; U.S., Urogenital sinus; C. Clitoris or penis; K., Pelvis of kidney; V., Vas deferens; R., Rectum.
37. Transverse Section of Fœtal Prostate at 3½ months. A, natural size; B, magnified; C, Portion of B more highly magnified (from micro-specimen 66).
38. Transverse Section of Prostate of Full-term Human Fœtus (from specimen 67).
39. Common form of Enlarged Middle Lobe of Prostate (from specimen 29).
40. Sacculated Bladder-wall (from specimen 30).
41. Prostate removed by suprapubic Prostatectomy (from specimen 45, case 1).
42. Bladder and Prostate after suprapubic Prostatectomy, showing the bed from which adenomata were removed (from specimen 35, case 30).
43 A & 43 B. Bladder and Prostate after suprapubic Prostatectomy, showing bed from which adenomata were removed, and a tear through the capsule into the sheath with consequent laceration of the veins, from which the patient died of hæmorrhage (from specimen 36, case 22).
45. Adenomata removed in one mass by suprapubic Prostatectomy (from specimen 43, case 11).
46. Vacuum Pump for suprapubic drainage.

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THE
DEVELOPMENT AND ANATOMY
OF THE
PROSTATE GLAND

ANATOMY.

THE prostate gland is one of the accessory organs of generation, whose function is to provide an abundant mucous secretion in which the spermatozoa can live. It surrounds the first part of the urethra—that part of the urethra which intervenes between the bladder and the superior layer of the triangular ligament of the perineum. It lies behind the symphysis pubis (fig. 14), from which it is separated by an interval of about half an inch; it is in front of the rectum, with the second portion of which it is in close contact; and the lowest point of the recto-vesical pouch of the peritoneum descends to within an inch of its posterior surface. At its sides it is embraced by the two levatores ani muscles (fig. 17), between which and the prostate there is the recto-vesical fascia, and separating this fascia from the prostate there is the prostatic plexus of veins. Above the prostate posteriorly there are the vesiculæ seminales and the terminal portions of the vasa deferentia, the common ejaculatory ducts of which penetrate the upper part of the posterior surface, and so gain the urethra. For clearness of description the prostate is said to have four surfaces, anterior, posterior, right and left lateral—a base and an apex; but although it is necessary to use such nomenclature, there are no well-marked divisions between these surfaces; on the contrary, they merge imperceptibly the one into the other. That part which is supported on the superior layer of the triangular ligament is the apex, and the wide surface which is in contact with and supports the bladder is called the base. Inasmuch as the prostate surrounds the first part of the urethra, the urethra is said to pass through the prostate, and is named the 'prostatic urethra.' It enters the superior surface a little in front of the centre, passes through the prostate nearer to its anterior than its posterior surface, and emerges at the apex, where it passes through the triangular ligament, about three-quarters of an inch behind the symphysis pubis, to be known as the second or membranous portion of the urethral canal. The apex of the prostate is a fixed point, so far as lateral and antero-posterior movements are concerned, but the rest of the prostate is capable of a limited amount of movement in accordance with the variations of the bladder and rectum. Such movements are possible because the prostate is everywhere surrounded by more or less yielding or muscular structures. It is this mobility which permits the passage of rigid metal instruments into the bladder per urethram. Although the apex of the prostate is fixed by the triangular ligament so far as lateral and antero-posterior movements are concerned, yet a slight amount of up and down movement is possible because the triangular ligament is not an altogether unyielding structure; accordingly, when the bladder is full and the rectum is empty, the prostate lies a little lower than when the bladder is empty and the rectum full.

Throughout this description the body is assumed to be in the erect position; the rectum being behind, the bladder above, the pubis in front, and the triangular ligament of the perineum below; the triangular ligament is then nearly horizontal in its antero-posterior as well as its transverse plane, and the two layers of the ligament will be called superior and inferior; the superior surface being towards the pelvis and supporting the prostate, and the inferior surface being directed to the perineum.

The following detailed account of the anatomy will be divided into two parts:

1. The prostate gland.
2. The relations of the prostate to the other organs and structures of the pelvis.

In the first division will be described:

1. Shape.
2. Size.
3. Weight.
4. The surfaces.
5. The capsule and commissure.
6. The stroma.

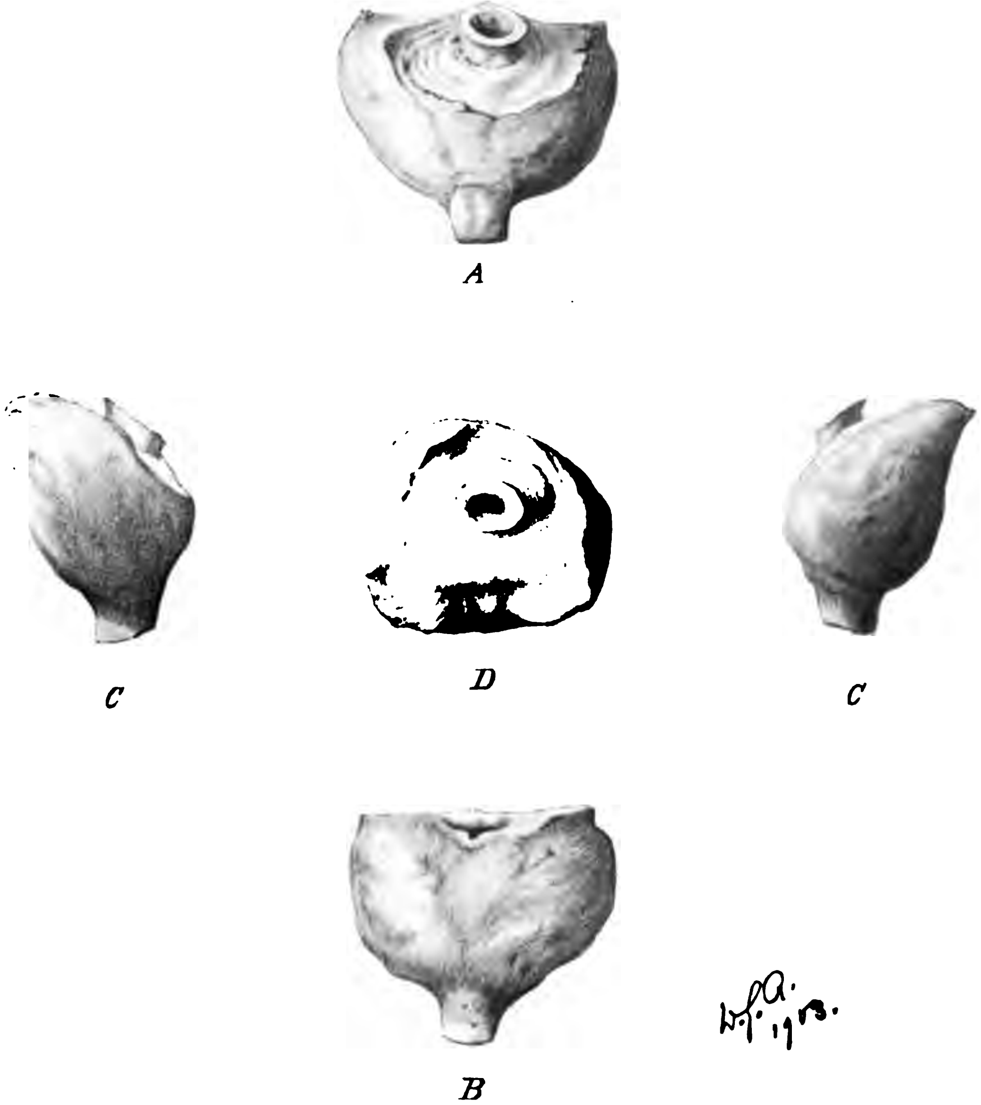

FIG. 1.

Normal Adult Human Prostate (from specimen 1).

7. The gland tissue.
8. The urethra.
9. The utricle and ejaculatory ducts.
10. The lobes.

In the second division will be described:

1. The levator ani.
2. The pelvic fascia.
3. The sheath.
4. Such other structures of which the anatomy must be clearly understood because of their relation to the pathology and treatment of diseases of the prostate.

Shape.—No better simile can be given than that the prostate is like a large chestnut, both in size and shape (fig. 1). It is rather flattened from before backwards, and it bulges out at the sides, mostly at their upper part. The base, which is towards the bladder, has rounded edges, which project slightly and so give the appearance of there being a slight constriction between the bladder and the prostate. This is most marked at the sides, and nearer the posterior than the anterior part: that is, it corresponds to the prominent bulging of the main glandular masses of the prostate. The anterior surface is more prominent down the centre, like a rounded keel, from which it shelves to both lateral surfaces. This greater prominence of the anterior surface is due to the fact that the urethra passes through the prostate nearer to it than to the posterior surface. The flatness of the posterior surface is due to the bulging of the lateral masses of the gland on each side. The greatest width is at the upper part of the prostate near the posterior surface. All four surfaces converge towards the blunt apex of the prostate; the anterior surface is only slightly inclined, the posterior is much more so, while the lateral surfaces converge with a rounded sweep.

Some prostates are much more flattened than others, and when the organ is of small antero-posterior diameter there is correspondingly greater prominence of the sides. Other prostates are much more nearly circular in transverse section; others again are not symmetrical, being round on one side and flattened antero-posteriorly on the other, in which case the organ projects much towards the upper and back part on the flattened side. According to my observation of a large number of healthy human prostates, slight asymmetry is the rule rather than the exception.

Size.—The prostates of healthy full-grown men vary considerably in size. They vary rather more than other organs, a fact which is of interest in connection with what is observed in animals, in which it will be noticed that the accessory glands vary greatly in different species, and also in the same species in accordance with the condition of sexual activity. I have not noticed in man that the seminal vesicles or Cowper's glands are larger than usual in cases in which the prostates are small. It cannot be said that there are definite normal dimensions of the adult human prostate; all that can be ascertained is the average size of a large number. Nor is it a matter of great importance to the surgeon at the present day, when operations are performed with wide open wounds in which any organ which is to be incised is clearly exposed. It was of great importance formerly, when, as in the operation of lateral lithotomy, the surgeon plunged his knife deep into the perineum with no other safeguard than 'the staff' in the urethra and his knowledge of the size of the prostate. Accordingly there were very careful measurements taken of large numbers of prostates, and though no two observers agreed as to the precise dimensions of the prostate, yet all arrived at an average which was nearly the same. Sir Henry Thompson gave the following dimensions as the average of thirty-three healthy adult prostates:

From base to apex . . .	1¼ to 1½ inch
Greatest transverse diameter, about	1¾ „
Greatest thickness, about . .	⅝ to ⅞ „

If the centre of the urethra be taken as a fixed point, in a transverse section of the prostate at right angles to the urethra, the greatest distance from this point to the capsule of the organ is in a direction backwards and outwards—that is, obliquely from the urethra towards the junction of the posterior and lateral surfaces; in this direction the incision in lateral lithotomy is made. It varies from three-quarters to seven-eighths of an inch.

Weight.—That which has been said as to the variability in shape and size of the prostate, and the impossibility of ascertaining what is the normal standard, applies equally to the weight of the organ. The prostate cannot be with certainty exhibited as a separate structure on account of its close connection with others. The amount of sheath which is left on one prostate after careful dissection may be more or less than that which is left on another; similarly pieces of capsule may be removed from one and not from another. The urethra may be divided higher or

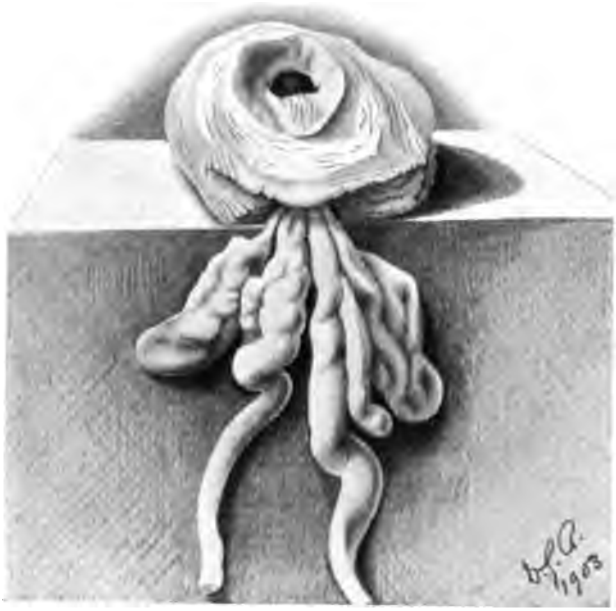

Fig. 2.

Normal Adult Human Prostate with Vasa Deferentia and Vesiculæ Seminales, viewed from above (from specimen 2).

lower in different specimens, and the canal at the back of the gland may be cleaned more or less perfectly. None of these variations in dissection are of great moment, but they are sufficient to cause differences in the weight of prostates which are conceivably the same. It is, however, agreed that the average weight given by Sir Henry Thompson is correct, viz. between four and a half and four and three-quarter drachms.

Surfaces.—There are four surfaces of the prostate: anterior, posterior, and two lateral—a base and an apex. These surfaces are not distinctly marked off, but pass almost insensibly the one into the other.

The *anterior surface* (fig. 1, A) is the shortest, and is nearly straight from above downwards, in which direction it measures about an inch. It lies nearly parallel to the posterior surface of the symphysis pubis, from which it is separated, about half an inch, by a layer of fat. The posterior surface of the symphysis pubis is convex, the higher part looking upwards and slightly backwards, while the lower part looks backwards and slightly upwards. The convex surface thus fits the angle between the bladder and the prostate, and it will be seen that the anterior surface of the prostate is therefore only in relation to the lower half of the posterior surface of the symphysis pubis. Transversely the anterior surface of the prostate is convex forwards, and widest at the upper part. It gradually tapers towards the apex and shelves off towards the sides.

The *lateral surfaces* (fig. 1, C) are convex from before backwards, and from above downwards. They are shorter, vertically, in front, where they meet the anterior surface, than behind, where they measure about an inch and a quarter. They form well-marked bulging sides to the prostate.

The *posterior surface* (fig. 1, B) is the most clearly defined. It is nearly flat from side to side, but convex from above downwards. Near the upper limit of this surface there is a depression, through which the ducts of the seminal vesicles and vasa deferentia pass. This depression divides the posterior surface into two portions, of which the lower is much the longer and more conspicuous (fig. 2). It is this lower and longer portion which is explored by the finger in examinations through the rectum; none of that part which is above the depression being palpable because it is covered by the vasa deferentia and the vesiculæ seminales with their dense fasciæ. The lower portion is slightly concave from side to side, but flat from above downwards. In some prostates the concavity is so marked as to clearly point to the organ being composed of two lateral lobes. It is smooth, and its capsule in this position has less dense attachments to the sheath than at any other part. It measures about an inch in vertical extent, and about an inch and a half transversely at its upper part, where it is widest. It tapers towards the apex. At the sides it passes with rounded but well-defined borders to join the lateral surfaces. The upper portion of the posterior surface is not clearly seen until after dissection. It is that part which lies above the depression through which the ejaculatory ducts pass, and is, in its central portion, the posterior surface of the middle lobe. In life it is completely covered by the seminal vesicles and the vasa deferentia. If, however, these structures be dissected away, there is exposed a surface which measures about a quarter of an inch vertically, and which is continued laterally to the sides of the prostate. Above, it joins the upper surface of the prostate.

The *apex* is that part which impinges upon the superior layer of the triangular ligament. At this point the fibres of the capsule of the gland are continuous with those of the triangular ligament.

The *upper surface or base* (fig. 1, D) of the prostate is that part of the organ which is in contact with the bladder. It can best be exposed by carefully tearing away the muscular fibres of the bladder, as has been done in fig. 2, and leaving the mucous membrane of the bladder, which will then be seen to be continuous with the mucous membrane of the urethra and to stand up like a trumpet with an interval between the mouth of the trumpet and the base of the prostate. When exposed in this manner, the base is seen to be a flat surface surrounding the urethra. It is about an inch in diameter in all directions; and inasmuch as the urethra penetrates it nearer the anterior than the posterior surface, there is rather a smaller area of the base in front of than behind the urethra. At the edges the base merges insensibly into the anterior, posterior, and lateral surfaces, from which it is distinguished not so much by any difference in direction of those surfaces as by the arrangement of the fibres. The fibres of the base have a circular direction the same as that of the muscular wall of the bladder, from which they have been separated, whereas the fibres of the bladder which pass to the outer surfaces are longitudinal, and when torn across they leave a somewhat rougher surface. When viewed from above in this manner, the base of the prostate is seen to be surrounded by inturned portions of the anterior, posterior, and lateral surfaces, but these inturned surfaces do not form an angular interval

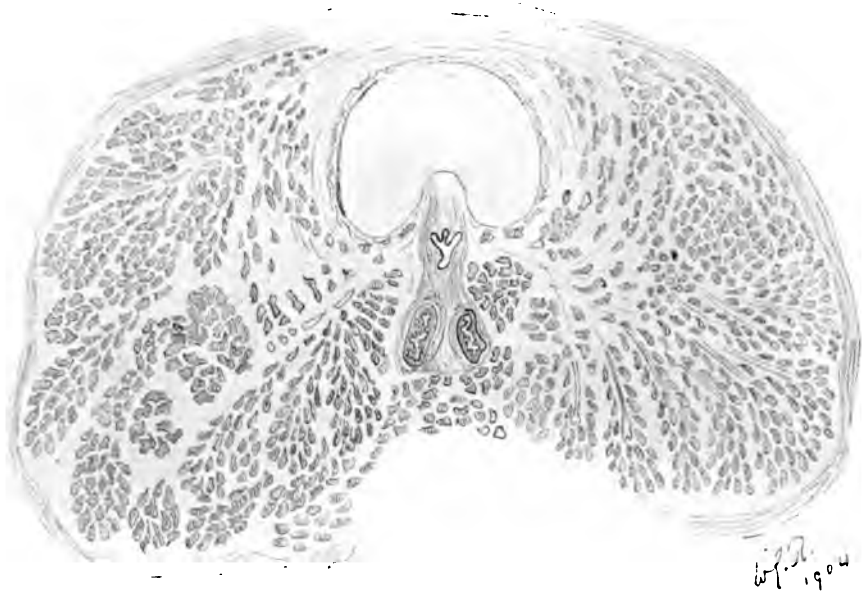

FIG. 3.

Transverse Section through middle of Human Prostate, slightly magnified, showing Capsule, Stroma, Anterior Commissure, Arrangement of Gland Tissue in Lobules, Common Ejaculatory Ducts and Utricle (from micro-specimen 64).

between them and the bladder. In life there is no sharply constricted neck; the angle which is seen during dissection is filled up by the longitudinal muscular fibres of the bladder, which pass directly to the surfaces of the prostate.

The Capsule.—It is usual and convenient to describe the investing membranes of the prostate as composed of separate portions—the 'capsule' proper and the 'sheath.' It must not, however, be supposed that these structures can everywhere be easily demonstrated as well-defined and separate structures; on the contrary, they are, over much of the surface of the prostate, so intimately blended as to be separated with difficulty. That this composite covering is derived from different sources, the one being the capsule of the prostate and the other being fascial, is certain. In animals there is a thin capsule of the gland, and, outside of this, a thin covering fascia, in which the veins course. All the fasciæ of the pelvis are very delicate in animals, and the muscles are comparatively much more developed than in man, in whom the fasciæ of the pelvis and perineum have been condensed in accordance with his assumption of the erect position and consequent necessity for greater strength in the pelvic floor. An increased support has been secured by greater density and firmer connection of all the fasciæ. In this closer union the capsule of the prostate and the adjacent fasciæ take part: to such an extent that, at certain positions, these separate structures appear as one investment. Its origin from three investments can be, firstly, seen on those parts of the gland where the connection is so loose as to allow of easy separation; and, secondly, inferred from the position of the veins. The prostatic plexus of veins lies among firm fibrous and involuntary muscular tissue; and this tissue is a highly developed and strong representative of the flimsy tissue found in quadrupeds. The sheath of the prostate can only be surely dissected from the capsule by using the plexus of veins as a guide, and dissecting them off with the firm connective tissue in which they lie. By doing so, the whole of the sheath may be removed and the capsule of the gland be exposed. The capsule then appears as a rather rough membrane, except upon part of the lateral and posterior surfaces, on account of the division of innumerable strands of fibres which pass from it to unite it to the sheath. The capsule forms a continuous investment for the prostate, and extends from the entrance of the urethra above to the triangular ligament below. It cannot be stripped off in the manner of a capsule such as that which invests the kidney. It is very firmly attached, and, if an attempt be made to strip it off by tearing, the detached portion will be found to have tiny pieces of the stroma of the gland adherent to it; and, on the other hand, the exposed surface of the gland will retain small shreds of the capsule. It varies in thickness, being thinner over the bulging sides than elsewhere. It is composed of fibrous tissue and involuntary muscle, the strands being arranged parallel to the surface and for the most part circularly around the prostate. On its deep aspect the capsule is structurally continuous with the stroma of the prostate (fig. 5), being composed of the same tissues, namely involuntary muscle and fibrous tissue. It appears indeed to be a somewhat condensed portion of the stroma without any gland tissue. Although the prostate is described as a single organ, it is known to arise as two separate glands. In a transverse horizontal section there is distinct evidence of such division, both in front and behind the urethra. In front of the urethra the *anterior commissure* is seen (fig. 3) to be a portion of the prostate which is devoid of gland. It is composed of the same tissues as the capsule of the organ, and the fibres run, for the most part, transversely and are in direct structural continuity with the stroma on either side. In the anterior part of the commissure there is a considerable quantity of voluntary muscle; this muscle is not of perfect form, the striation not being so well defined as in healthy muscle. This is of much interest in connection with the development and comparative anatomy of the prostate. Behind the urethra, although there is gland tissue uniting the two lateral lobes, yet there are septa of fibro-muscular tissue which pass backward from the urethra to the capsule and thus divide the prostate into two lateral masses.

The Stroma.—When a prostate is divided in various directions and the cut surfaces are examined with the naked eye, it has a pinkish grey colour and a uniform appearance rather like dense felt. This is due to the fact that the substance of the prostate is composed of three tissues—involuntary muscle, fibrous tissue, and gland cells—combined in what appears at first sight to be an irregular felt-like mass. On closer examination of the cut surface with a magnifying glass, such as is used with the ophthalmoscope, it will be seen that there are innumerable fine strands of what looks like fibrous tissue dividing the substance of the prostate into minute areas (figs. 3, 4, 5), and it will be further observed that there is a general convergence of the strands from all parts of the periphery towards the urethra and mostly towards the back of the urethra (fig. 3). If a prostate which has been treated with formalin solution and methylated

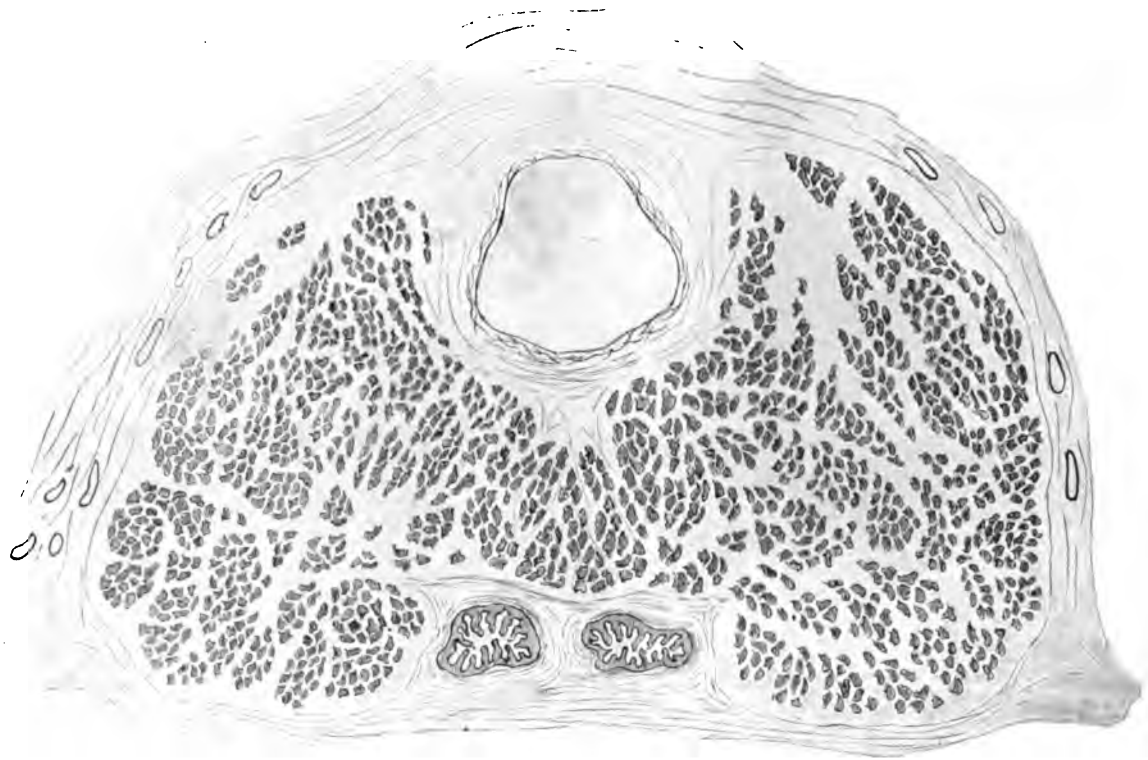

Fig. 4.

Transverse Section of Human Prostate close to Bladder. slightly magnified, showing Capsule, Stroma, Sheath, Anterior Commissure, Lobules of Lateral Lobes, separate Lobules of Middle Lobe focussing on back of Urethra, and the Ejaculatory Ducts (from micro-specimen 63).

spirit, and preserved in glycerine, be divided through the middle, and the divided portions be kept in the open air until they are becoming rather dry, it will then be very clearly seen that each lobe is composed of different tissues; for while much of such a section changes to a brownish semi-transparent substance, among it will be seen a multitude of yellow opaque granules, arranged with a general radiation from the side and back part of the urethra towards the capsule of the organ. These yellow opaque bodies are the glandular, secreting portion, and the darker semi-transparent part is what is known as the stroma of the prostate. The two tissues, stroma and gland, exist in about equal proportions, but the stroma is most abundant in that part of each lobe which is nearest to the capsule, to the anterior commissure, and the urethra, while the gland tissue is found chiefly towards the outer and posterior part.

The stroma is composed for the most part of plain muscle fibres, but among the muscle there are much fibrous tissue and a few elastic fibres. There is no hard and fast line between the stroma and the capsule, the fibres of the one interlacing closely with those of the other. Some of the fibres attached to the deep surface of the capsule are arranged together in strands which pass into the substance of the prostate, and have a convergent course to the posterior part of the urethra. These strands pass among the gland tissue and help to subdivide it into lobules in a somewhat incomplete manner. The chief part of the stroma, however, has no visible plan of construction: that is, the fibres are disposed irregularly among the gland tissues and between the more defined strands. In the neighbourhood of the anterior commissure, the fibres of the stroma are in direct continuity with the fibres of the commissure, and around the urethra also they blend with its circular muscle sheath.

The Gland Tissue.—As has been already mentioned, the stroma of the prostate is arranged in a convergent manner from the capsule to the back of the urethra. These convergent strands split the prostate into a large number of lobules (fig. 3), and each of these lobules is in reality a separate gland. Of the many ducts which are seen to open in the prostatic sinuses of the urethra, each conveys the secretion from a lobule, which may thus be looked upon as a separate gland. In this the prostate of man is like the simpler prostate of an animal such as the beaver (fig. 31), though in man the lobules are so closely bound together that the arrangement is not clearly seen until sections are made. The duct runs down the centre of each lobule, and it gathers the secretion from the many small tubules which radiate from it. The tubules are very closely packed together (fig. 6), and between some of them there is a very small amount of stroma, which is not regularly disposed, as is the muscle of an artery; the fibres of the stroma lie parallel to but not circularly around the surface of the tubules. Between the tubule and the stroma there is a thin layer of connective tissue (fig. 7), in which the vessels lie, and upon the connective tissue there is a basement membrane which separates it from the glandular epithelium of the tubule. The walls of the tubules are not regular, but are corrugated in transverse sections, so that the lining of the tubule appears to be folded; by this means a large secreting surface is obtained. The secreting epithelium is columnar next to the lumen of the tubule, but beneath the columnar cells there is a layer of rounder cells, with larger nuclei, upon the basement membrane. In the most glandular part of the organ the tubules are so closely and irregularly packed, that the stroma also has the appearance of being irregular.

Urethra.—That part of the urethra which extends from the outlet of the bladder to the triangular ligament is about an inch and a quarter in length, and is, in its entire length, surrounded by the prostate gland (figs. 14 and 17). It lies nearly vertical, and slightly curved with the concavity towards the pubes. Although it is invested by such a tough organ as the prostate, it is the most distensible portion of the entire urethra. In shape it is fusiform, being narrower at each end than in the intervening portion. It is narrowest at the apex of the prostate, being less than a third of an inch in diameter at that point, while at the outlet from the bladder it is somewhat wider, being a full third of an inch. Between these two points it is expanded in a spindle shape, and measures nearly half an inch at the middle, where it is of greatest width. If the prostate be divided transversely from above downwards in such a way that the knife passes down the centre of the urethra, dividing it into an anterior and a posterior half, and the anterior half be removed, the posterior portion, or 'floor of the prostatic urethra,' will be exposed, and the following anatomical features can be noted (fig. 8): It is narrow at each end and expanded between those points. Extending along the whole length, in the middle line, from the bladder to the membranous portion of the urethra, there is a ridge, and on each side of the ridge the floor is depressed. This ridge, which is known by the various names 'caput gallinaginis,' 'crista urethræ,' 'colliculus seminalis,' and 'verumontanum,' begins at the outlet of the bladder, at a

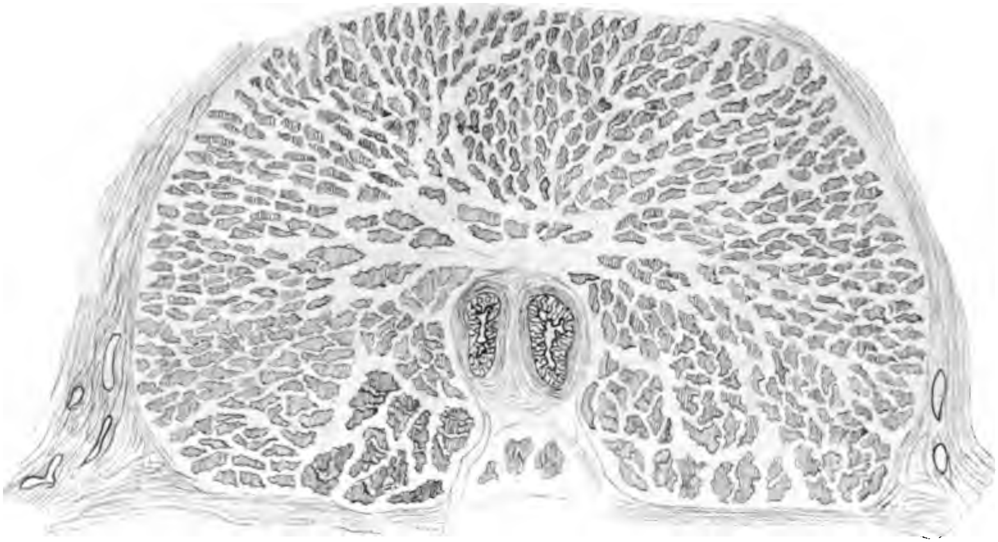

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FIG. 5.

Coronal Section of Human Prostate behind Urethra, slightly magnified, showing Sheath, Capsule, Stroma, Lobules of Lateral Lobes, separate Lobules of Middle Lobes, and the Ejaculatory Ducts (from micro-specimen 62).

little mound which is situated almost within the bladder, and is known as the uvula vesicæ, and which owes its prominence partly to a layer of longitudinally arranged involuntary muscle, which lies under the mucous membrane at this point. It is further made prominent by the presence of the middle lobe of the prostate beneath it. Commencing at this point, the ridge, or verumontanum, has a very slight elevation, but as it passes down the urethra, it gradually rises higher and higher, with a more pronounced crest and a slightly wider base, until at a point a little below the centre of the prostatic urethra it reaches its highest elevation; from this point the verumontanum rapidly diminishes until it almost disappears at the lowest point of the prostatic urethra. The depressed portion on either side of the verumontanum is known as the prostatic sinus, and on the surface of each sinus a number of minute openings of ducts can be seen with the aid of an ordinary magnifying glass; these are the open mouths of the ducts of the prostate gland, those of the right lobe opening into the right prostatic sinus, and those of the left lobe opening into the left sinus. They are variously estimated at from fifteen to thirty in each sinus. The verumontanum is not a mere straight keel stretching between the uvula vesicæ and the highest point of the crest; it follows the receding posterior wall of the expanding urethra, and then rises to the summit of the crest, forming a saddle-shaped structure. There are two other well-marked ridges in the prostatic urethra, which are seen in the specimen from which fig. 8 is copied; from the sides of the verumontanum, at a point nearer to the bladder than the summit, these ridges pass, one on each side, upwards and outwards to terminate at the outlet of the bladder on either side about an eighth of an inch external to the uvula vesicæ. They thus inclose a V-shaped area, with the point of the wedge downwards, and they form a barrier which marks off this area from the prostatic sinus on each side. The middle lobe of the prostate lies beneath this V-shaped area. On the crest but immediately below the peak of the verumontanum, just where it begins to dwindle, there is a small slit-like opening with its long diameter in the direction of the long axis of the urethra—this will admit the end of an ordinary probe, which can be pushed upwards and backwards for a third of an inch; the probe will then be in the 'prostatic utricle,' which is also named the 'sinus pocularis,' 'vesicula prostatica,' and 'utriculus masculinus,' and is the representative in the male of the female vagina and uterus. The lips of the outlet of the utricle lie in contact. About the centre of each lip, or just within the lip, or even below the lower end of the mouth of the utricle, there is a minute pore which will admit a hog's bristle. These small openings are the outlets into the urethra of the common ejaculatory ducts. The mucous membrane of the prostatic urethra has the same general characters as that of the bladder, but it is more delicate. It has layers of stratified cells, the superficial layer being flattened, the next layer columnar, and the deepest layer small-celled with large nuclei. Beneath the epithelium there is a basement membrane, and outside this membrane a thin layer of connective tissue which separates it from a layer of longitudinally arranged involuntary muscle. This layer of muscle is continuous with a similar layer under the mucous membrane of the bladder; it forms a complete investment for the urethra, but is most marked under the verumontanum, which eminence is chiefly due to this muscle. External to the longitudinal fibres there is a layer of circularly arranged involuntary muscle, which is found to be a continuation of the circular fibres of the bladder (fig. 11); it extends from the base of the prostate to the apex, and is continued in the membranous portion of the urethra.

The anterior half of the prostatic urethra, 'the roof,' has the same structure as 'the floor,' but without any distinctive features. When the urethra is distended the mucous membrane is perfectly smooth, but when it is collapsed it is thrown into fine longitudinal wrinkles. This wrinkling is also seen in the floor and sides of the urethra when it is not distended.

There are numerous mucous glands in the prostatic urethra.

Transverse sections of the prostatic urethra at different situations have not the same outline. At the outlet of the bladder its greatest diameter is transverse with a slight convexity forwards caused by the uvula vesicæ. At the centre it is crescent-shaped on account of the prominence of the verumontanum and depressions of the prostatic sinuses. At the apex the urethra is circular.

Utricle and Ejaculatory Ducts.—Near the upper margin of the posterior surface of the prostate there is a depression, and at the bottom of the depression the opening of a canal which descends obliquely downwards and forwards as far as the urethra, at the wall of which it stops immediately under the highest point of the verumontanum (fig. 9). This canal is about an eighth of an inch in diameter throughout, and in it the two common ejaculatory ducts and the prostatic utricle are found. The opening of the utricle below the summit of the verumontanum, and the appearance of the orifices of the ejaculatory ducts in the edges of the

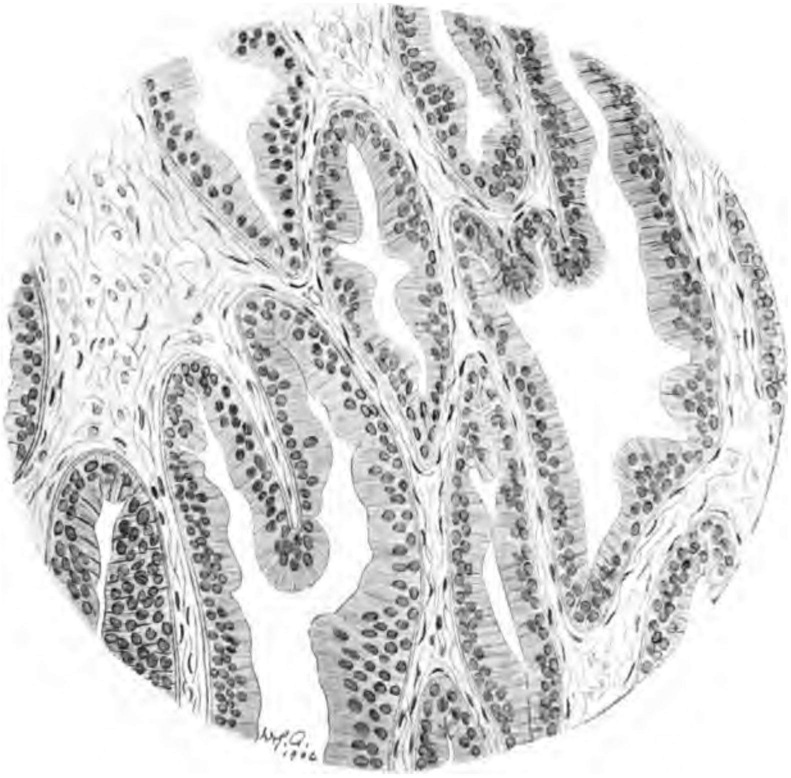

Fig. 6.

Microscopic Section of Human Prostate, showing Stroma, Basement Membrane, and Arrangement of Gland Epithelium. Tubules mostly in longitudinal section (from micro-specimen 64).

lips of that opening, have already been described. By removing the posterior part of the prostate which covers the canal behind, and then from the urethra passing a probe into the utricle, it can be very easily seen and separated (fig. 8, A). The utricle is then found to be a narrow blind tube, like a test tube, with the blunt end in the canal and the open mouth in the urethra. It varies in size in different prostates, but is about a third of an inch in length and a twelfth of an inch in thickness. The mouth is somewhat narrower than the rest of the cavity; the walls are composed of involuntary muscle and lined by areolar tissue, upon which lies the mucous membrane, which is folded so as to appear like papillæ in cross section. External to the muscular coat there is a layer of connective tissue which is one with the rest of the fibrous tissue which fills the cleft. Except where the utricle perforates the urethra, it is nowhere, strictly speaking, *in* the prostate; that is to say, it is in no way enveloped by the capsule of the prostate nor in contact with the stroma of the gland.

The utricle can be more easily demonstrated in the following way. If the mucous membrane of the prostatic urethra, and then the layer of longitudinal muscle which lies under the mucous membrane, be carefully removed, it will be seen that the prominence of the verumontanum is mostly due to this layer of muscle, which exists in large amount; and as it is being removed it will be seen that it divides into two strands, one of which passes on each side of the mouth of the utricle. When these strands have been removed, the open end of the utricle will be seen to stand clearly projecting into the urethra. If, before beginning this procedure, the common ejaculatory ducts have been severed from the vasa deferentia and the vesiculæ seminales, the projecting mouth of the utricle can be seized with dissecting forceps, and the entire utricle with both common ejaculatory ducts can be withdrawn per urethram. Bristles can then be passed down each ejaculatory duct, and it can then be clearly seen how they lie in and upon the wall of the utricle and open at the orifice of that tube. The connective tissue around the utricle and ejaculatory ducts is the homologue of the broad ligaments of the female.

Lobes.—In animals the prostates are two separate glands, which are situated one on each side of the urethra. In man there is a division into two lateral halves, although the indications of that division are not so clear as in animals. Bound together as these two portions are in the human prostate, yet the prostate is said to have two lobes, and, so far as the glandular portion is concerned, this is true, for on section it can be clearly seen that the secreting tubules of the gland are collected together in a separate mass on each side of the urethra. These masses occupy the major portion of the prostate, being most conspicuous towards the hinder part of each lobe; they discharge their secretion into the corresponding half of the urethra only, and are in reality two separate glands. At the upper and posterior part each glandular mass is united to its fellow of the opposite side by a collection of gland tissue which lies below the base of the bladder, behind the posterior wall of the urethra and in front of the tunnel for the common ejaculatory ducts (figs. 4, 5, and 9). This mass of gland is called the third or middle lobe, or the median portion of the prostate. It is true that it is not completely separate from the lateral lobes, with which indeed it is structurally continuous on each side, but it is nevertheless different from the main masses of the prostate. Its anatomical position in the middle line seems to mark it off from the rest of the gland as a separate portion. When the vasa deferentia, the seminal vesicles, and the common ejaculatory ducts have been removed, it can be seen to project as a small mound on the posterior aspect of the prostate immediately above the depression for the seminal ducts, in the interval between that depression and the base of the bladder (fig. 1, D, and fig. 2). This piece of the gland lies under a different part of the urethra from the lateral lobes, viz. not under either prostatic sinus, but under a higher part of the posterior wall of the urethra immediately below the uvula vesicæ in that V-shaped area previously described. It is more commonly the seat of pathological change than the rest of the prostate. It is often the only part of the organ which enlarges in old age, and when so enlarged it appears to be quite independent of the rest of the prostate. For these reasons it appears to merit a distinctive name; what that name may be is not of great importance, whether it be 'median portion' or 'third lobe' or 'middle lobe.' Whether its existence be denied or admitted, there is no escape from reference to it both in anatomy and pathology.

General Relations of Prostate.—When a man stands in the erect position, the symphysis pubis is nearly horizontal, *i.e.* the deep or pelvic surface looks upwards and a little backwards, and the superficial surface looks downwards and a little forwards. The arch of the pubes is thus directed backwards, and the crest forwards. The tip of the coccyx is on the level of the middle of the symphysis pubis, and the promontory of the sacrum is nearly vertically above the posterior edge of the symphysis, being a little posterior to the symphysis. These are important landmarks to

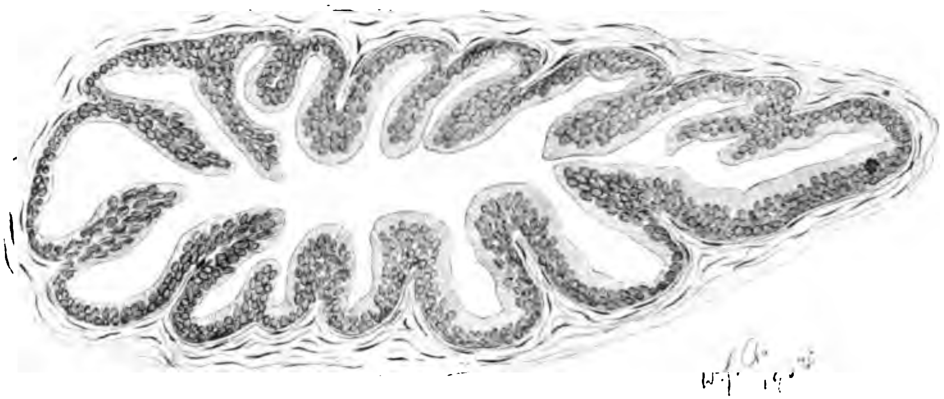

FIG. 7.

Tubule of Human Prostate cut in Transverse Section, showing Connective Tissue, Basement Membrane, and Arrangement of Gland Epithelium (from micro-specimen 64).

bear in mind in order to obtain a clear picture of the position of the prostate gland.

If a needle be passed from in front immediately above the symphysis pubis horizontally backwards (fig. 14), it will pass through the base of the bladder, just missing the upper surface of the prostate, then through the second part of the rectum, and will touch the coccyx a little above (half an inch) its termination.

If another needle be similarly passed immediately below the symphysis pubis, it will pass through the triangular ligament obliquely, just missing the apex of the prostate, then through the junction of the second and third part of the rectum, and will miss the coccyx altogether, passing more than half an inch below it. If a vertical transverse section of the pelvis be made through the entire length of the prostate, the membranous urethra, and the bulb of the corpus spongiosum, it shows well the relative position of the various structures in contact with the lateral surfaces of the prostate (fig. 17).

In the following description of the muscles and fasciæ of the pelvis, it is assumed that the subject is in the erect position. For convenience it is customary to speak of the pelvic fascia as though it were a special structure, but it must be borne in mind that it is in reality a composite structure formed by thickened, and in parts well-marked, portions of the ordinary fascial coverings of the muscles and other organs. All muscles are enveloped by a covering sheath; but where strength is required, any part of a sheath or of adjoining sheaths is thickened to a greater or less extent. For example, that portion of the pelvic fascia which covers the obturator internus is a distinct, well-developed fascia, with attachments to bones and ligaments at the edge of the obturator internus muscle. By this, however, it must not be understood that the obturator fascia is only a portion of the general pelvic fascia, which receives a particular name because it is in relation to the obturator internus muscle: it is, on the contrary, the proper fascia of the obturator muscle itself, and it has connections with the fascial coverings of neighbouring muscles and other pelvic structures, and so enters into the formation of the pelvic fascia. In man the fasciæ of the pelvic structures are strong, and the muscles are relatively ill developed; but in quadrupeds it is the muscles which are most evident in dissections, and the fasciæ are thin and flimsy. In man the fasciæ are so much and so firmly united to one another that they give the appearance of being one complete fascia which sends off expansions here and there to cover the muscles; but in quadrupeds it is evident that the pelvic fascia is only a composite structure made up of the combined fasciæ of the muscles and other organs (fig. 21). Similarly the covering fascia of the levator ani muscle receives different names on its two surfaces: on its inner surface—that towards the prostate and rectum—it is named recto-vesical fascia; but on the outer or lower surface of the muscle it is named the anal fascia. Yet again that part of the recto-vesical fascia which passes between the pubes and the front of the prostate is called the pubo-prostatic ligament, while another portion is named the lateral true ligament of the bladder.

So far as the prostate is concerned, the pelvis may be considered to be bounded by the fascial covering of the levator ani (the recto-vesical fascia) at the sides (fig. 17), by the pubes in front, by the rectum behind, and by the triangular ligament of the perineum below (fig. 14).

Levator Ani.—The levator ani muscles arise from the posterior surface of the pubes, from the white line of the pelvis, and from the spine of the ischium. From the back of the pubes some of the fibres of the muscle pass backwards over the superior layer of the triangular ligament, to which they are attached both in front and at the sides of the prostate, being inserted posteriorly into the central point of the perineum. This portion of the levator ani is known as the levator prostatæ, and only comprises one part of the muscle, the rest of which is inserted around the sides of the terminal portion of the rectum and the structures behind it. It is chiefly that part of the muscle named the levator prostatæ which is in anatomical relation to the prostate. It forms a complete lateral covering to the prostate, its inner surface being closely applied to the side of that organ, its outer surface being covered by the anal fascia and in contact with the fat which occupies the anterior extremity of the ischio-rectal fossa. The lower border of the muscle lies nearly horizontal. This portion passes close to the apex of the prostate, and with its fellow of the opposite side almost surrounds the urethra at that point. There is an interval between the external surface of this part of the muscle and the ramus of the pubes, conical in shape, with the base towards the ischio-rectal fossa, a continuation of the fat of which fills the space. This space is bounded on the outer side by the obturator muscle and fascia, below by the triangular ligament, and on the inner side by the levator ani and the anal fascia.

Pelvic Fasciæ.—The essential structures in the pelvis are not the fasciæ, but the viscera and the muscles, with their vessels and

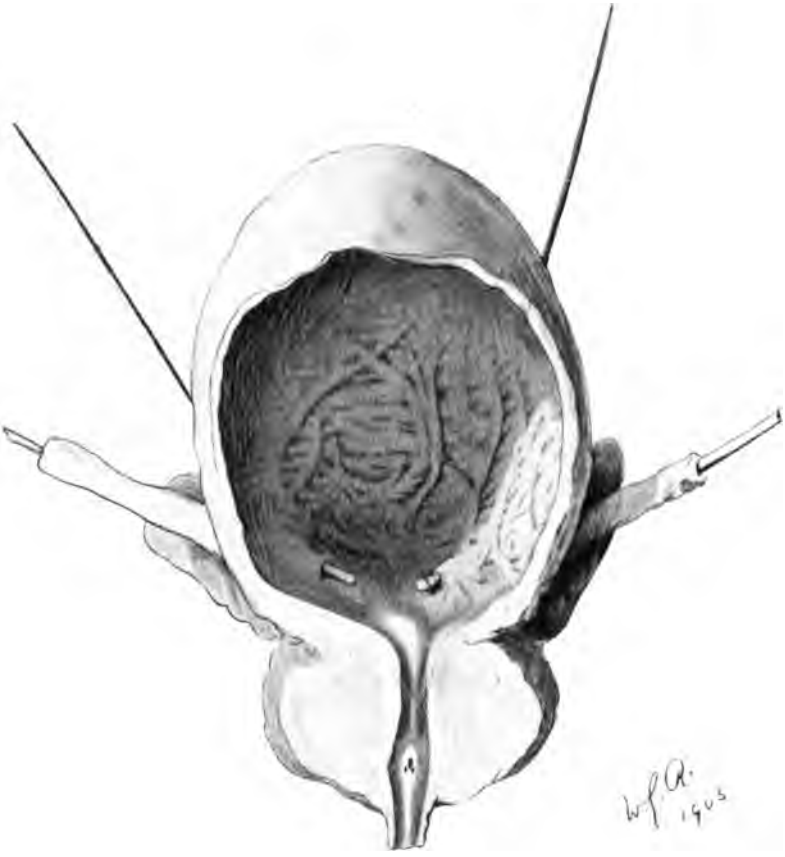

Fig. 8.

Coronal Section of Bladder, Prostate, and Urethra (from specimen 4).

nerves. The fasciæ are merely the covering tissues of these structures, which unite more or less firmly wherever they come in contact, as, for example, where the levator ani comes in contact with the obturator internus from the pubes to the spine of the ischium; along that line the fascia which covers the obturator muscle is united very firmly to the sheath of the levator ani, in what is known as the white line of the pelvis (fig. 21). That part of the sheath which covers the inner surface of the levator ani is spoken of as an expansion from the pelvic fascia, which passes inwards and then divides into two layers, one of which passes upwards and covers the bladder and rectum, and another which passes downwards to envelop the prostate and the rectum; but I shall endeavour to show, both by dissections of the human pelvis and by comparison with the anatomy of animals, that these layers are the proper fascial coverings of the viscera, which have connections, firm in one part and loose in another, where they come in contact with the recto-vesical fascia, and where strength is required; but that the recto-vesical fascia is nothing more than the sheath on the inner aspect of the levator ani, and that it does not at any point send off expansions either to the bladder or to the prostate; and that it is not connected to its fellow of the opposite side by an expansion from itself, but that what is described as an expansion from each recto-vesical fascia, between the prostate and the rectum, is in reality a double layer of fascia, of which one portion is derived from the fascial covering continuous with that which envelops the bladder, and the other is derived from the fascial covering of the rectum (fig. 14).

Recto-vesical Fascia.—The recto-vesical fascia is attached along the white line of the pelvis; at the anterior end of the line it is attached to the obturator fascia below the hollow through which the obturator vessels pass, and in front of this it is attached to the back of the pubes. Behind the ischial spine it joins the pyriformis fascia, and between them the sciatic vessels and nerves pass out of the pelvis. From this line of attachment, which is the same as the line of origin of the levator ani muscle, it spreads over the entire inner surface of the levator ani, and is attached to the same structures as those into which the muscle is inserted. Posteriorly it is a somewhat flimsy fascia where it passes by the rectum, but in the anterior part of the pelvis it is a strong well-defined membrane, which can be best demonstrated by exposure from the external or perineal aspect (fig. 20) If such a dissection be made, the recto-vesical fascia will be very clearly seen as soon as the levator ani muscle is removed; and while removing the muscle it will be noticed that the fibres are loosely attached to, and capable of a good deal of play upon, the fascia. As seen from this aspect, the fascia has a continuous close attachment in its upper portion from the pubes to the spine of the ischium, and the line of attachment has a general direction upwards and backwards. The outer surface is a clean smooth fascia, which slopes from its upper attachment downwards and slightly inwards. At the posterior part, between the spine of the ischium and the rectum, it is a broad surface, but it gradually narrows towards the anterior part at the back of the pubes. Its inferior line of attachment cannot be demonstrated like the upper On the outer surface of the rectum it is lost among the muscle and fibrous tissue; between the rectum and the prostate, it is also lost, on the surface of the triangular ligament, among the felt-like tissue which occupies the midline of the perineum; at the sides and anterior to the prostate it has a similar attachment, which is continued as far as the posterior surface of the pubes, where it is attached to the periosteum. The recto-vesical fascia is thus seen to be an easily defined structure when viewed from the outer side, and it will be further noted that it does not completely envelop the prostate and the rectum. It presents on this aspect a slightly convex surface which approaches the midline towards the pubes and behind the rectum, but there is only an indication of the contour of either the prostate or the rectum, the interval between the two being filled up by other structures.

On its inner surface this fascia is in much more complicated relationship to the structures which it passes. At its anterior attachment to the pubes it is close to the fascia of the opposite side; from this point it spreads backwards and expands in vertical dimensions. Behind the prostate it passes back, gradually diverging from its fellow until it reaches the side of the rectum.

That part which reaches from the back of the pubes to the prostate is named the pubo-prostatic ligament, or anterior true ligament of the bladder.

Another portion named the lateral true ligament of the bladder is a strengthened piece lying between the attachment below the obturator canal and the lateral aspect of the neck of the bladder. Immediately behind the prostate the recto-vesical fascia is joined by the transverse fascia which intervenes between the rectum and the prostate.

Pubo-prostatic Ligaments.—These ligaments are thickened portions of the recto-vesical fascia, in which is found much involun-

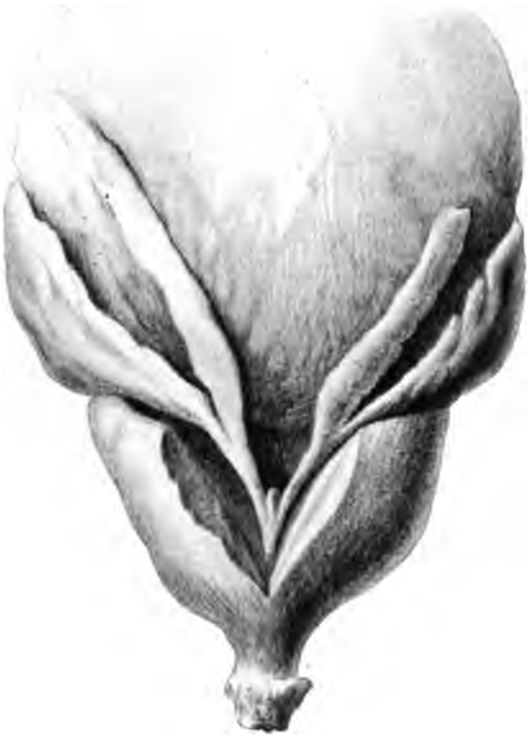

Fig. 8a.

Posterior view of Bladder, Prostate, Seminal Vesicles, Vasa Deferentia, Common Ejaculatory Ducts, and Prostatic Utricle (from specimen 4).

tary muscle fibre derived from the bladder. They are clearly seen to be two definite bands of tissue when approached through a suprapubic wound and in dissections in which the bladder is pressed back from the pubes (fig. 21); under such circumstances each ligament is put on the stretch, and is seen to be parallel to its fellow of the opposite side, and to reach from the back of the pubes, near the middle line, to the junction of the bladder and the prostate, at which point it becomes one with the detrusor muscle of the bladder. Between the two ligaments there is an interval which is filled up by fibrous tissue; this tissue is attached to the pubo-prostatic ligament on either side, to the triangular ligament below, and to the anterior surface of the prostate, and is in contact with the retropubic fat above. In this felt-like mass of fibrous tissue, the dorsal veins of the penis are embedded. If, however, these pubo-prostatic ligaments be examined in cross and antero-posterior sections, they have a very different appearance, and it must be remembered that the position in which they are seen when demonstrated from above the pubes is a position which they cannot assume during life. In the natural position the interval between the neck of the bladder and the pubic attachments of these ligaments is only about half an inch (fig. 14); the ligaments do not pass straight across between these points, but bend downwards from the pubes and then rise up on the anterior surface of the prostate until they reach the bladder, forming a cup-shaped surface, into the hollow of which the retropubic fat dips. In a cross section the ligaments cannot be seen as two well-defined structures; they gradually merge into the intervening tissue in which the penile veins lie embedded (fig. 19). These ligaments are evidently somewhat thickened and strengthened portions of the recto-vesical fascia, and I shall endeavour to show that the position of the veins on the inner aspect of the recto-vesical fascia at this point is maintained throughout by the prostatic and vesical veins. The pubo-prostatic ligaments become lost below in the somewhat indefinite structure called the superior layer of the triangular ligament.

The Superior layer of the Triangular Ligament.—This is a structure which cannot be demonstrated as a well-defined fascia. It is really an anatomical expression for the blending of a number of fasciæ entering into it. From above there are: the sheath of the levator ani as it passes round the lower edge of that muscle, and changes its name from recto-vesical fascia to anal fascia; the fascia lying between the pubo-prostatic ligaments; the fibrous tissue which passes from the prostate in front, behind, and from both sides; and the rectal fascia. From below there are: the fascial covering of the constrictor urethræ; the felt-like tissue in which Cowper's glands lie; the fascia of the transversus perinei; and the fascia surrounding the penile vessels. All these fasciæ become firmly blended, and they form in the aggregate a structure which cannot be demonstrated by dissection, but which is a convenient anatomical expression. It cannot, for instance, be separated from the fibrous tissue between the pubo-prostatic ligaments, and on its inferior surface it is not separable from the tissues surrounding Cowper's glands..

Rectal Fascia.—Over the upper portion of the rectum, in that part which has a mesentery, the peritoneum surrounds the bowel; beneath the peritoneum there is a layer of loose fibrous tissue which is continuous on its outer surface with the fibres of the peritoneum, and on its deep surface with the fibrous tissue which everywhere passes in strands among the longitudinal muscle fibres of the rectum; by this means the peritoneum is bound to the rectum. This fibrous tissue is in such quantity on the lower part of the rectum that it can be dissected as a fascia. Between the peritoneum and this fascia—the rectal fascia—fat is readily deposited; in stout persons it accumulates in large amount, and in all persons it is found beneath the peritoneum covering the second portion of the rectum. If the rectal fascia be dissected downward, it will be found to become more dense and more easily demonstrated as it descends on the anterior surface of the bowel, until it becomes continuous with the triangular ligament, or, rather, with the felt-like mass of fibrous tissue which lies between the urethra and the rectum (fig. 14). The rectal fascia behind the prostate is more lightly connected both in front and behind than elsewhere, and it is readily seen both by dissection and in sections, whether taken transversely or vertically from before backwards. Its connection with the rectum is made by fine fibres, and its connection anteriorly is of a still looser nature to the fascia covering the back of the prostate. Laterally this piece of the rectal fascia is united to the recto-vesical fascia just behind the outer edge of the posterior surface of the prostate on either side (fig. 22). The recto-vesical fascia at this point is vertical, with its lower edge joined to the triangular ligament and the plane of its inner surface lying antero-posteriorly. The rectal fascia, on the other hand, while also vertical, has its plane lying transverse to the pelvis. The two fasciæ are at right angles to each other, and the shape of the piece of rectal

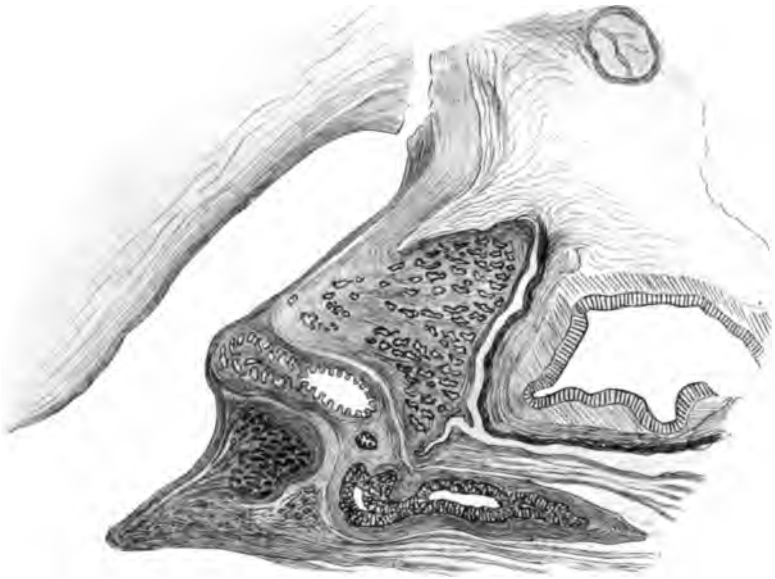

Fig. 9.

Sagittal Section of Human Prostate in Middle Line, slightly magnified, showing Urethra, Outlet of Bladder, Rectum, Prostatic Utricle, Common Ejaculatory Duct, Middle lobe, and Cowper's Gland (from micro-specimen 60).

fascia is roughly the same as that of the posterior surface of the prostate.

Vesical Fascia.—The same general description of the fascia of the rectum holds good for that of the bladder, particularly over that portion which is covered by the peritoneum. If a line be drawn from each ureter forwards to the apex of the bladder and another be drawn uniting the ureters across the posterior part of the bladder, a triangular area—the upper surface—will be mapped out, the apex being at the apex of the bladder and the base having a curved outline with its convexity towards the back of the prostate. This area is entirely covered by the peritoneum, between which and the muscular wall there is much loose fibrous tissue which permits distension of the bladder and in which there is no fat. In the latter particular the vesical fascia differs on the upper surface from its condition over the rest of the bladder. In front and below this area there is always some fat on the bladder wall (figs. 14 and 17), and in very stout persons it accumulates in large amount, filling up the interval between the pelvic fascia and the bladder both in front and at the sides, so that in such persons when the viscus is empty and is viewed from above the superior surface of the bladder is seen lying in a hollow among the fat. There is always a distinct division of this fat into two portions—one belonging to the pelvic wall and one to the bladder. This can be most clearly demonstrated in vertical and horizontal sections, in which the fatty layer of the bladder and that of the pelvic wall are seen to be very loosely united to one another. There is a vertical cleft between the two, across which fine fibres only pass, and in preserved specimens the two portions will fall apart unless supported (figs. 14 and 17). Between the bladder and the pubes this cleft reaches down close to the pubo-prostatic ligaments, on the surface of which the two layers of fat unite, and in a suprapubic operation it is the layer of bladder fat and not retropubic fat through which the incision into the bladder is made, the retropubic fat being divided in the parietal incision. On the sides of the bladder the fat reaches from the line of the obliterated hypogastric artery above (which corresponds to the line uniting the ureter and the apex of the bladder) to the neck of the bladder below. At the hinder part of the sides of the bladder the fat reaches as far as a line drawn downwards from the ureter towards the upper and posterior corner of the prostate (figs. 20 and 22). Along this line the fat becomes much tougher, having in its midst many large veins and much muscular and fibrous tissue.

The deep surface of this layer of fat is continuous with a layer of fibrous tissue, the same as that which covers the superior surface of the bladder, which not only forms a covering for the bladder itself, but also for the vasa deferentia, the vesiculæ seminales, and the prostate gland.

It will be most easily described if it be followed down from the superior surface over the front, the sides, and the back of the bladder.

In front it forms a loose fibrous tissue, which passes in strands and fibres among the bundles of muscle of the bladder wall, and, as it descends, it becomes more intimately connected to the muscle, until the two cannot be separated at the neck of the bladder, where they both pass into the fibrous tissues in front of the prostate, the point of union being a very dense tissue, which is firmly united to the capsule of the prostate. The pubo-prostatic ligaments have been previously described as strengthened portions of the recto-vesical fascia. They are augmented by and largely composed of fibrous strands and involuntary muscle from the neck of the bladder; these strengthening bands pass over the tissues in which the veins lie, and they are so clearly defined that they give the appearance of being extensions of the pubo-prostatic ligaments. In this way the recto-vesical fascia seems to give off an expansion to the bladder (fig. 21).

Down the sides the relation of the vesical fascia to the bladder is the same as in front, but at the neck of the bladder there is not so much muscle and fibrous tissue passing over the veins; the union of the recto-vesical and the vesical fasciæ is not so intimate here as in front (fig. 21).

Behind the fascia is most perfectly developed, and it can be demonstrated as a distinct, firm, fascial sheath, which passes downwards towards the upper edges of the vasa deferentia and the vesiculæ seminales (fig. 22). Just as it reaches this position it is not so firmly connected to the bladder, but it is denser itself and forms a distinct sheet. It splits into two portions, one of which passes in front of the vasa deferentia and the vesiculæ, between these structures and the bladder, and the other passes behind them; that part which passes in front is rather more firmly attached to the vesiculæ than to the bladder, from which it can be easily separated with the handle of a scalpel, and it passes downwards until it reaches the prostate, upon the capsule of which it runs forward between the bladder and the prostate and down on the anterior surface of the canal for the ejaculatory ducts. That part which passes behind the vasa deferentia and

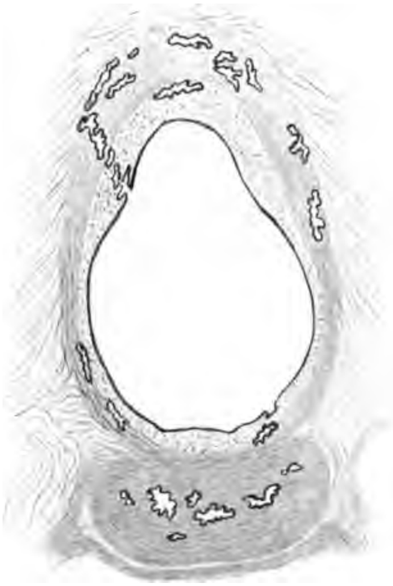

FIG. 10.

Transverse Section of Human Urethra at Apex of Prostate, slightly magnified (from micro-specimen 65).

seminal vesicles is also attached to the capsule of the prostate immediately behind those structures in a transverse line, the strands of fibres running for the most part transversely and showing no indication before dissection of the line of union between the fascia and the prostate. This part of the fascia is very strong, and it is so closely united to the lower edge of the vesiculæ seminales by its inner surface that the vesicles themselves appear to be attached to the prostate. Along the outer edge of the vesicles these two sheets of fascia—that from in front and that from behind the vesicles—unite again, and they thus form an enveloping capsule for the vasa deferentia and the vesicles, which appear to be held firmly against the base of the bladder by them.

Beyond the outer edge of the vesicles this fascia is lost in a mass of firm, fibro-fatty tissue, which exists between the ureter above and the prostate below. In this position it unites with the fascia of the side of the bladder, and in the dense mass of connective tissue large veins pass upwards from the penis, prostate, seminal vesicles, and the bladder, to enter the internal iliac vein (figs. 21 and 22).

The Sheath of the Prostate.—If the recto-vesical fascia be removed carefully, it will be found to be a thin fibrous sheet, and internal to it there will be left a sheet of tissue completely covering the prostate; this is composed of firm connective tissue, in which there is, near the neck of the bladder, fat and muscle fibre, and in which the veins of the prostatic plexus are embedded. It is continuous with the superior layer of the triangular ligament around the apex of the prostate, and, at the base of the prostate, it is continuous with the fascia of the bladder. At the apex it is thin, but towards the neck of the bladder it is thick. In front of the prostate it is continuous with the tissue which lies behind the pubes, and in which the veins of the penis are embedded. Over the back of the prostate this fascia unites above with the layer of vesical fascia which has just been mentioned as forming the covering of the posterior surfaces of the seminal vesicles; it is a firm sheet of fibrous tissue which covers the back of the prostate, lying between the prostate and the rectal fascia, to both of which it is somewhat loosely united and from each of which it can be easily separated; below it joins the superior layer of the triangular ligament, and at each side it passes round the posterior borders of the prostate to join the fascia covering its lateral surfaces.

This fascia is the true sheath of the prostate. On its external surface it is united to the recto-vesical fascia by strands of fibrous tissue, but the two can be readily separated the one from the other, and, as above stated, when this is done the recto-vesical fascia is seen to be a firm, though thin, fascial sheet. The fascia covering the prostate is a fibro-fatty layer, continuous at the neck of the bladder with the fascia of the bladder, of which it appears to be an extension, and just as the vesical fascia is intimately connected to the bladder, so this fascia is closely united to the prostate, particularly at the neck of the bladder, at which situation the veins of the prostate pass from the gland to the prostatic plexus. In this fascia the veins lie embedded in the tough connective tissue; none passing between the recto-vesical fascia and the sheath of the prostate. Such a description of the anatomy of the sheath of the prostate appears to me to be not only true from a dissector's point of view, but also to be in keeping with the morphology of the genito-urinary organs.

Veins.—The dorsal vein of the penis pierces the triangular ligament close to the pubic arch, and so enters the pelvis, where it is embedded in the fibro-muscular tissue which lies in front of the prostate and between the pubo-prostatic ligaments. Near the upper part of the anterior surface of the prostate it divides into a right and left branch, which pass upwards and backwards on the surface of the prostate close to the neck of the bladder. As they pass the sides of the prostate they are joined by vesical and prostatic veins, some of which do not immediately enter the penile veins, but run a short distance by their sides and thus give the appearance of a venous plexus. Farther on they pass upwards to join the internal iliac veins, and as they pass the outer edges of the seminal vesicles they are joined by vessels from the posterior surfaces of the bladder and prostate and from the vesiculæ seminales. The veins of the upper surface and sides of the bladder course downwards and backwards over the posterior portion of the bladder towards the junction of bladder and prostate; at this point they turn outwards between the bladder and the front of the seminal vesicles. The veins of the seminal vesicles begin at the depression in the prostate for the ejaculatory ducts, and course upwards and outwards on both surfaces of the vesicles. Many veins from the posterior surface of the prostate course upwards on either side of the middle line, and then turn outwards and upwards on the layer of vesicle fascia at the back of the vesicles.

In the course of dissection it is evident that, so far as the contents of the pelvis are concerned, they may be divided into

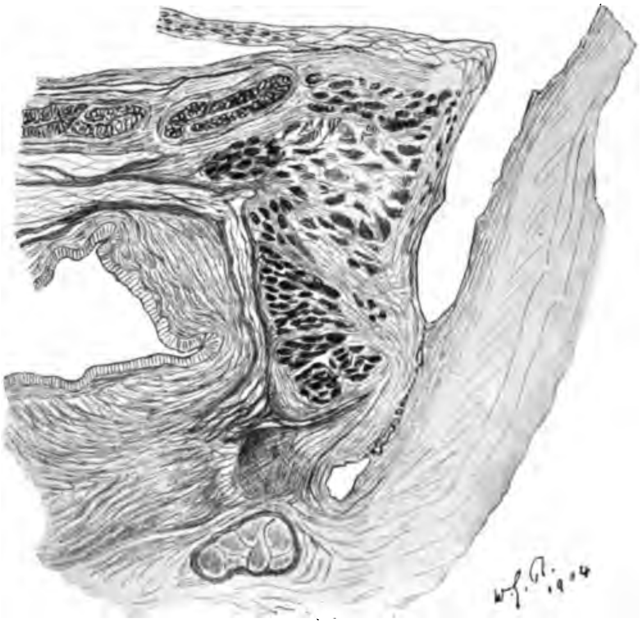

FIG. 11.

Sagittal Section of Human Prostate at side of Urethra, slightly magnified, showing Continuity of Muscular Wall of Bladder with that of Urethra (from micro-specimen 61).

two portions—those belonging to the parietes and those belonging to the viscera. The parietal structures are the voluntary muscles with their fasciæ. They cover the bony wall of the true pelvis on either side, and they occupy a large part of the cavity of the pelvis, leaving a comparatively small oval space in the centre. This space extends from the back of the pubic symphysis to the front of the sacrum and coccyx, and is bounded laterally by the obturator, pyriformis, and recto-vesical fasciæ. The vessels and nerves of these parietal structures all lie external to those fasciæ; and the muscles, with the exception of the levator ani, all belong to the limbs. The levator ani is also a parietal structure inasmuch as it forms, with its covering recto-vesical fascia, the most important part of the floor of the pelvis, and only comes into structural relationship to the viscera at the positions where it is perforated by the urethra and the rectum. The internal pubic vessels pass forward among these parietal tissues to supply those portions of the genital organs which are derived from the ectodermal cloaca. Below the peritoneum the central oval cavity of the true pelvis is wholly occupied by the rectum and the genito-urinary organs with their vessels. This cavity is subdivided into an anterior and a posterior portion by the rectal fascia, which has been described as uniting with the recto-vesical fascia on each side; in the posterior division the rectum lies, and in the anterior the genito-urinary organs. To the rectum the middle hæmorrhoidal vessels pass from the internal iliac artery and vein; to the genito-urinary organs the vesical vessels pass. The former pierce the rectal fascia above the point of union of the rectal and recto-vesical fascia and so enter the posterior division; while the latter pass downwards in front of the rectal fascia towards the point of union of the bladder and the ureter. The anatomy of the contents of the pelvis, when viewed in this way, is in keeping with development; the rectal fascia thus marking the position of the septa which, in the early embryo, divided the *ento*-dermal cloaca into an anterior or genito-urinary and a posterior or rectal portion. The rectal fascia also terminates below at the posterior edge of the triangular ligament and thus joins the perineal structures, which were formed by the bridge of tissue that divided the *ecto*-dermal cloaca into genital and anal portions. The line of union of the levator ani muscles with the urethra is also of interest, inasmuch as it is immediately above Cowper's glands, which are known to be penile glands and developed in connection with the anterior division of the ecto-dermal cloaca, while the genito-urinary sinus which lies above the levator ani is developed from the ento-dermal cloaca: *i.e.* the line of union of the levator ani corresponds to the position of the cloacal membrane. The most important conclusion to be derived from this view is that the pelvic genito-urinary organs are entirely separate both from the rectum and from the recto-vesical fascia. It is true that around the neck of the bladder, particularly in front, there are connecting bands of fascia between the prostate and the recto-vesical fascia, but those bands may be accounted for in another way than by supposing that the recto-vesical fascia belongs to the genito-urinary system. It is more consistent with what is seen in dissections of the adult, with comparative anatomy and with embryology, to look upon the bladder and urethra, with the genital ducts and glands which enter them, as being entirely separate, morphologically, from the surrounding pelvic muscles and fasciæ, and as being invested by their own proper fasciæ.

It can be demonstrated that there is a distinct layer of fascia covering the bladder and the prostate, and that the vasa deferentia and vesiculæ seminales are bound to the base of the bladder by this layer of fascia. It does not unite with the recto-vesical fascia at the sides, but passes round the posterior edge of the prostate to join the fascia covering the sides of that organ (fig. 22). In these investing fasciæ the veins of all these viscera lie, and while they receive the veins from each viscus, yet they are not joined by any veins from the parietal structures; no veins pass from the recto-vesical fascia to the prostatic plexus; on the other hand, all the genito-urinary organs from the glans penis to the vasa deferentia pour their return blood into them. The presence of the investing fascia of these viscera in which the veins of each viscus lie, seems to point to a common origin separate from the adjacent fasciæ.

Summary.—The following is a brief summary of the main features of the anatomy of the human prostate as described in the foregoing pages:

1. It is of the size and shape of a large chestnut.
2. It measures 1 inch vertically on its anterior surface, 1¼ inch vertically on its posterior surface, and 1⅓ inch in greatest breadth.
3. It weighs between 4½ and 4¾ drachms.
4. It surrounds the first portion of the urethra, which passes through the organ rather nearer the anterior than the posterior surface.
5. The glandular portion is collected mostly into two main masses, called lateral lobes, which are situated chiefly in the

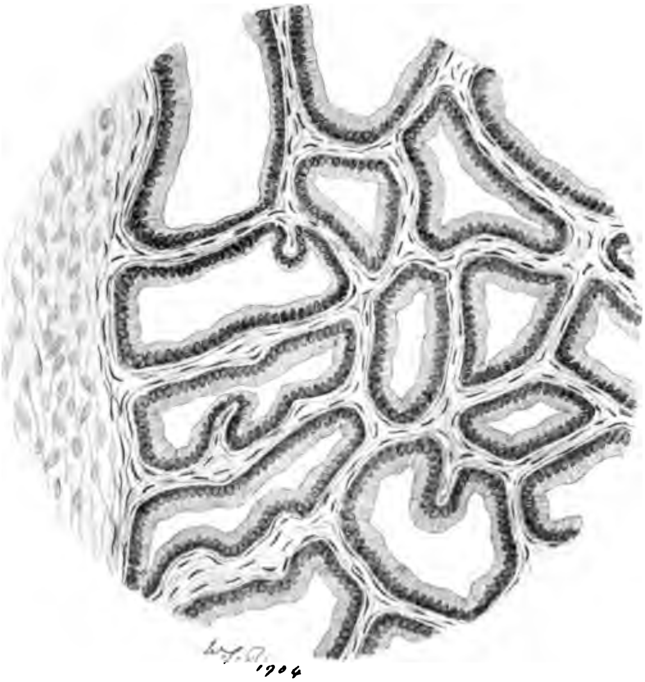

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Fig. 12.

Microscopic Section of portion of Seminal Vesicle
(from micro-specimen 60).

posterior and outer part, and discharge their secretion by ducts into the sinus prostaticus on either side of the verumontanum.

6. There is a portion of the gland which lies behind the urethra, below the outlet of the bladder and above the canal for the ejaculatory ducts; this portion discharges its secretion into the V-shaped area at the back of the urethra close to the outlet of the bladder; and it is continuous on each side with the lateral lobes. It is a distinct portion of the prostate and is called the 'middle lobe,' 'median portion,' or 'third lobe.'

7. The capsule is a firm envelope which is everywhere intimately connected to the stroma of the organ on its inner surface, and it is also connected, though not so intimately, on its outer surface with the fascial sheath of the prostate.

8. In the fascial sheath the plexus of veins is embedded, and they are found mostly on the anterior surface and around the sides near the junction with the base of the bladder.

9. The recto-vesical fascia is bound to the sheath laterally, but it is a separate structure which belongs to the pelvic wall and not to the genito-urinary tract.

COMPARATIVE ANATOMY.

Comparison of the accessory genital glands of animals with those of man is of great assistance in forming a correct conception of the anatomy and physiology of the human prostate. It is not enough to merely compare the prostate glands of animals with the prostate glands of man, because the prostate is only one of three glands which are all accessory to the testicles; these three glands are the vesiculæ seminales, the prostates, and Cowper's glands; each of which serves the same purpose—namely, to provide an abundant fluid in which the male germ cells can live both during coitus and, subsequently, until impregnation takes place. The seminal vesicles carry out that function during the passage through the lower part of the vas deferens, the prostates during the passage through the uro-genital urethra, and Cowper's glands during the passage through the penile or genital urethra.

The following observations appear to thrust themselves upon one when the genital glands of mammals are compared:

The *testes* exist in all; they are not only present in each animal, but they are of striking similarity in all; their outward likeness is noticeable, and their minute structure and course of development is equally alike; in this the testes differ from the accessory genital glands—the seminal vesicles, the prostates, and Cowper's glands—which are not only very dissimilar in outward form and minute structure in different animals, but they are not always present: sometimes one and sometimes another being either absent or perhaps greatly enlarged; in one animal the seminal vesicles being present and of enormous size (fig. 26), while in another they may be absent altogether (fig. 24). The same observation applies to the prostate and Cowper's glands (figs. 25 and 29). There must be a deep meaning in such a condition.

It is agreed that the testes are *the* essential male organs of reproduction; whether impregnation can be effected by spermatozoa without the aid of the secretion of the accessory genital

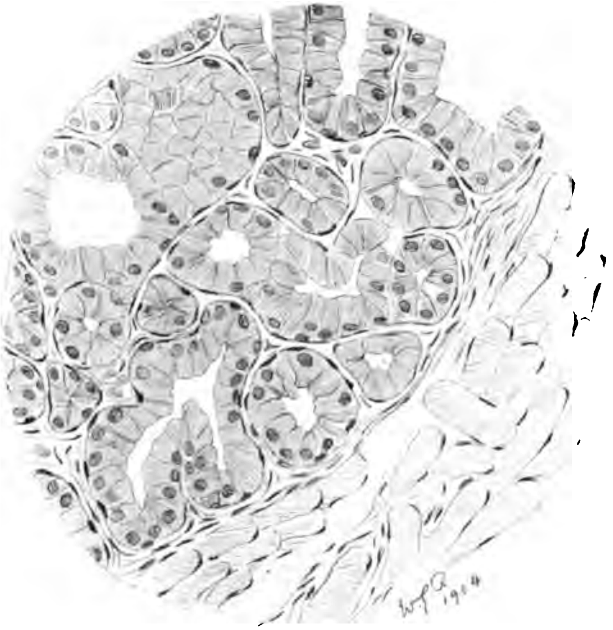

Fig. 13.

Microscopic Section of Cowper's Gland (from micro-specimen 60).

glands is uncertain. It is certain, however, that no impregnation can be effected by an animal which is devoid of testes, and that the size of the accessory genital glands bears some proportion to the fecundity of the animal. If it be granted that impregnation cannot occur without the aid of the secretion from the accessory genital glands, it yet leaves the question of the special function of each of those glands unanswered. It cannot be maintained that any one of them is essential to fertilisation, because sometimes the seminal vesicles, sometimes the prostate glands, and sometimes Cowper's glands are either very small or absent altogether; therefore, if the secretion of these glands is essential, it must have the same composition in all, and in an animal which has no seminal vesicles the function of the vesicles must be carried out by one or other of the remaining accessory glands; or, again, in an animal devoid of both seminal vesicles and prostates, their function must be carried out by some gland which is present. It appears to me that these accessory glands all have the same function to perform—namely, to provide a medium in which the spermatozoon can live in its passage through the genito-urinary canal of the male and in the genital canal of the female. The presence of three kinds of glands for the same purpose, I would suggest, arises in the mode of development of the genito-urinary organs; that the seminal vesicles carry out their function for that part of the track which springs from the Wolffian duct; the prostate for that part which has its origin in the anterior portion of the entodermal cloaca—the genito-urinary sinus—and Cowper's glands for that part which is developed from the ectodermal cloaca—the penile urethra. In reviewing the anatomy of the sexual glands of animals, references must be made to the utriculus masculinus for the purpose of seeing whether any support can be derived for the suggestion that the diseases of the human prostate, which arise about the time of cessation of sexual activity, are in any way homologous with those occurring in the human uterus about the same period. The evidence obtained from comparative anatomy is against such a conclusion, for in those animals in which a male uterus is present it is a distinct and separate structure from the prostates; the ducts of the prostates enter the urethra apart from the utricle, and their walls are not in contact; except in the hare and rabbit, in which the prostate and utricle are united by their adjoining surfaces. Examination of the beaver and the goat shows that there is no connection or similarity between the prostates and the male uterus.

Vas Deferens and Seminal Vesicle.—In the course of the development of the genito-urinary organs, a bud or diverticulum springs from the lower end of the Wolffian duct; this diverticulum becomes developed into the whole or part of the kidney and the ureter; in course of time, the attachment of the ureter to the Wolffian duct becomes altered in position and finally joins the urinary canal separately; the interval between the points of entry of the Wolffian duct and the ureter becoming wider and wider until, in the adult, they are separated by the length of the vesical trigone. In a similar manner, a second diverticulum springs from the lower end of the Wolffian duct to form the seminal vesicle, and, just as in the case of the ureter, so also, in many animals, the seminal vesicle becomes detached from the vas deferens (Wolffian duct) and opens into the uro-genital sinus separately. This is the case in some rodents, *e.g.* the agouti and the beaver, in the anteater, the elephant, hyrax, swine, and slow lemurs. The complete separation of the seminal vesicles from the vasa deferentia in these animals, and the consequent absence of any direct communication between the two, seems to controvert the belief that the office of the vesicles is that of a reservoir for the spermatozoa. It is hardly conceivable that in some animals these organs should perform the function of reservoirs; that in other animals, in which the vesicles open direct into the urethra, they should act as mucous glands; and that both these important functions should be unfulfilled in such animals as are devoid of seminal vesicles.

I would suggest rather that the function of the seminal vesicle is that of a mucous gland only, and that it serves the same purpose as the prostate gland. The most careful provision is made throughout the uro-genital tract for the protection or sustenance of the male germ-cell in its passage; this provision is seen, in the first place, in the lower end of the vas deferens, which is, as a rule, expanded, the expansion being due to great thickening of the glandular mucous coat, and not to a dilatation of the tube. Another feature of interest, in the condition of the lower end of the vas deferens, is the similarity of that part to its associated seminal vesicle; when the vas deferens has some marked peculiarity, such as is observed in the elephant, the corresponding seminal vesicle shows the same character. This expansion of the lower end of the vas deferens is very marked in animals which have no seminal vesicle, as though the function of both were performed without the budding off of the vesicle as a separate structure.

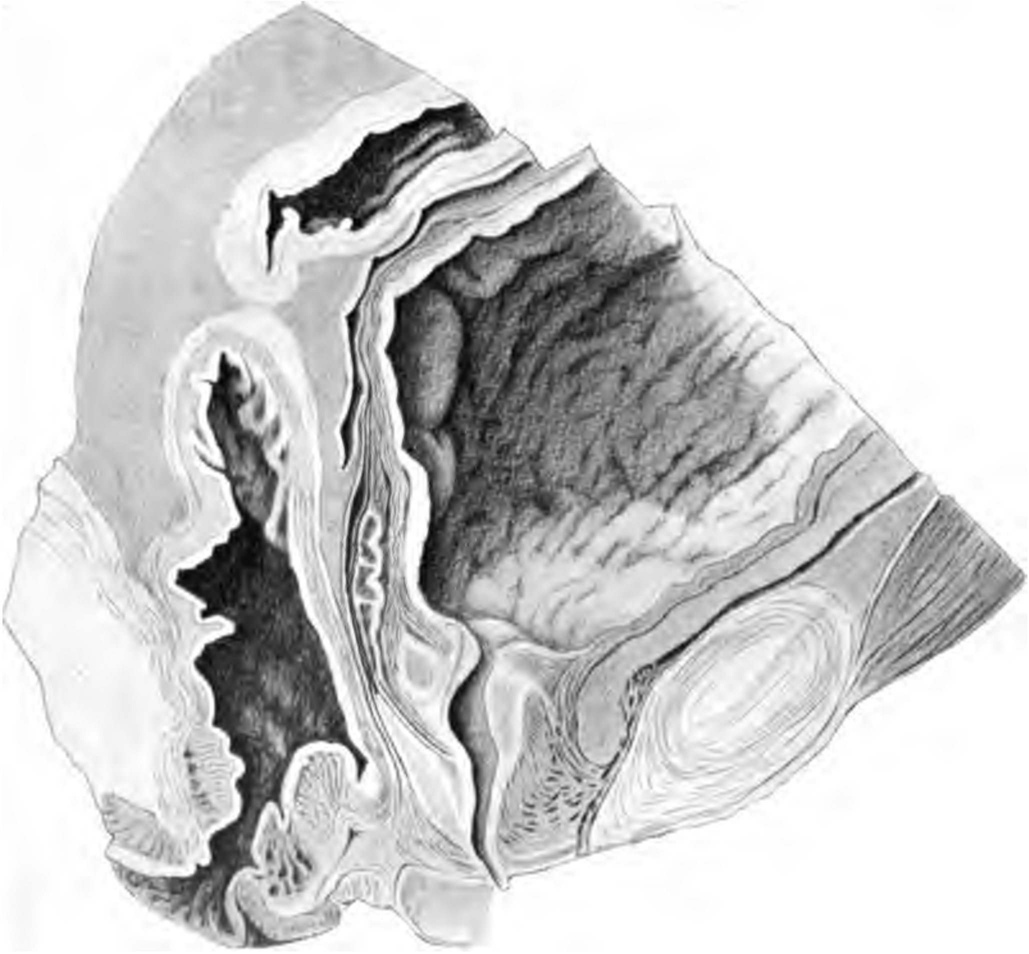

Fig. 14.

Sagittal Section of Adult Human Male Pelvis in middle line (from specimen 6).

Prostate.—There are no prostate glands in the ornithorhynchus, or in the echidna, in the sloth, or in the suricate. In marsupials (figs. 23 and 24) the prostate is represented by a great thickening of the mucous lining of the first part of the urethra, to such a degree that this portion of the tract is as prominent an object as the prostates themselves in most animals. If it be true that the function of the accessory genital glands is to provide a mucous vehicle for the germ cells, some provision might be expected in those animals which are devoid of prostate glands for their absence; in the ornithorhynchus and the echidna, this appears to be brought about by enlargement of other accessory glands, and it is interesting to observe that although there are no seminal vesicles in these animals, yet the lower ends of the vasa deferentia are enlarged, and Cowper's glands are of larger relative size. In the sloth and in the suricate there are no seminal vesicles, and the absence of prostate glands is made good by the presence of very large Cowperian glands.

In those animals which have prostate glands there is great diversity both in the relative size and shape of each gland; but there are other characters which are the same in all.

The features of similarity are, first, the position of the glands with regard to the genito-urinary canal, and, secondly, their essential composition, which is that of compound tubular glands.

First, as to the position of the prostates.

In animals it is usual to speak of the prostates, not of the prostate, as in human anatomy, because even when the two glands are more or less united to form one mass, as in the dog, it is evident that the mass is composed of two portions, one of which discharges its secretion into the right side of the urethra and the other into the left side; but in a great number of animals there is not only a line of division of the mass into two halves, but the two portions are entirely separate and distinct glands (fig. 28); this, in fact, is the typical condition, and it will be seen to have an important bearing on the development and anatomy of the human prostate. Just as there are two seminal vesicles and two Cowper's glands, so there are two prostates—a right and a left gland. The ducts of each gland open into the urethra on the same side as that on which the gland itself rests; no ducts pass across the middle line; and there are always large numbers of ducts, no prostate terminating in a single duct. The prostates always have the same position on the urethra, in relation to the other organs which discharge their secretion into that canal; they always open at a point somewhere in what is called the first part of the urethra, or the muscular urethra, in animals, *i.e.* that portion which intervenes between the bladder and the urethral bulb, or, in other words, that portion which is developed from the ento-dermal cloaca. This muscular urethra is so called because in animals it is enveloped by a well-defined layer of voluntary muscle—a fact of much interest, as will be seen when studying the human prostate, in which there is a complete stratum of voluntary muscle in the fœtus, and, even in the adult, a few striated fibres. Into this portion of the urethra the openings of the vasa deferentia, the seminal vesicles, the utriculus masculinus, and the prostate ducts enter, and the orifices of these have the same relation to one another—the prostates always entering lowest, that is farthest away from the bladder, and on either side of the middle line.

Second, as to the arrangement of the tubules of the glands. The simplest form of prostate is seen in such an animal as the guinea-pig (fig. 26), in which it is formed by a number of cæcal diverticula, which open upon the inner surface of the urethra, and project from the sides as a collar of radiating tubes. In some animals this simple form of prostate exists, while in others the arrangement is somewhat more complicated, the tubules being twisted and bunched together into a compact mass, as in the mole in the rutting season (fig. 27); while in others the tubes have branching diverticula, which are more firmly bound together and give the organ a firm consistence, as in the rabbit; again, in others, as the dog, the subdivision of the tubules is finer still, and approaches nearer to the condition found in the human prostate.

Cowper's Glands.—Cowper's glands are of interest in connection with the comparative anatomy of the prostate for two reasons: first, because they appear to have the same function as the prostate glands and seminal vesicles, and to bear some proportion to them in size, being large when the prostates and vesicles are small, and small when the prostates and vesicles are large; secondly, because they exercise that function in a distinct portion of the genital tract—namely, the penile urethra. With regard to the first point, it must be noted that it does not apply in the case of rodents; but at the same time it must be remembered that this class of animals usually have all the accessory glands of enormous size, bearing some relation to their marvellous power of reproduction—a power so amazing that, in all countries where rodents exist, if the conditions be favourable, they quickly increase in such numbers as to become a serious plague.

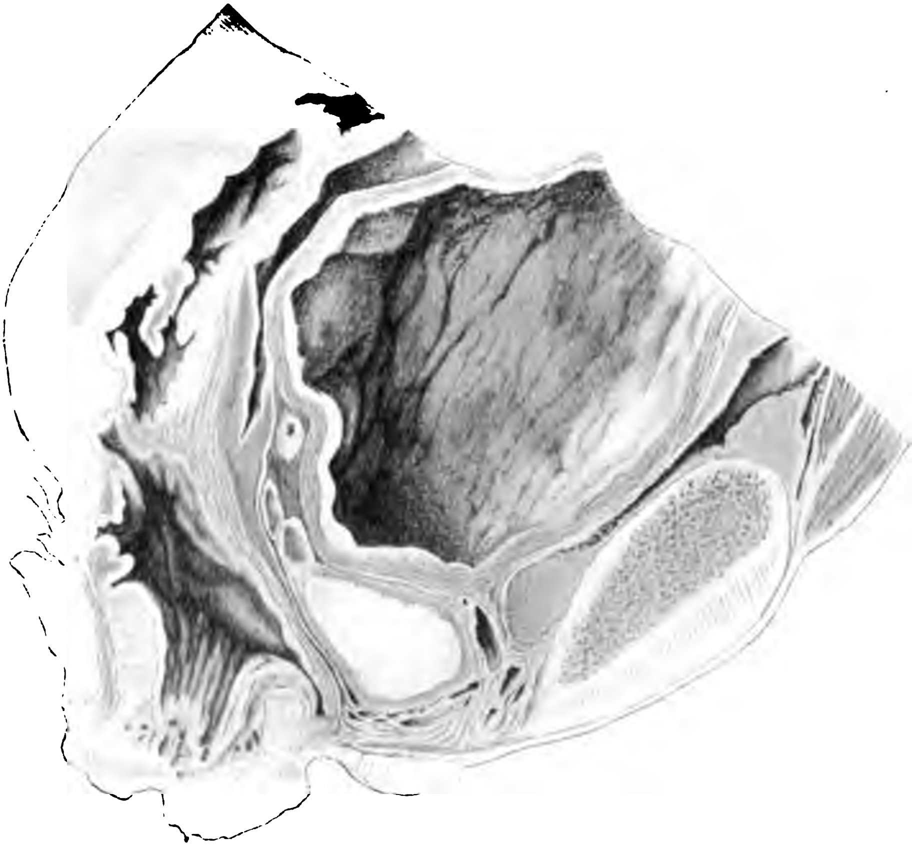

Fig. 15.

Sagittal Section of Adult Human Male Pelvis, $\frac{1}{3}$ inch to left of middle line (from specimen 7).

With regard to the second point, Cowper's glands are of interest because of their relation to the penile urethra—that part which in human pathology is chiefly viewed as having a urinary function, but which was originally a purely sexual organ; as in the ornithorhynchus, in which also Cowper's glands are highly developed. In the monotremata, to which order of animals the ornithorhynchus belongs, the genito-urinary passage opens into a cloaca at a point anterior to the rectum.

'The vascular tissue of *the penis* commences at the termination of the uro-genital canal. The *urethral canal* of the penis begins by a small orifice at its root, communicating with the termination of the uro-genital passage, and by the combined action of the retractor penis muscle with the sphincter cloacæ it can be brought into contact with the terminal papillæ of the sperm ducts. Such temporary continuation of the urethral and seminal passages takes place during the vigorous muscular and vascular action of the parts in coitu, the semen being then propelled from the one along the other without escaping into the cloaca. Under ordinary circumstances, as when the urine is transmitted along the uro-genital passage, that fluid escapes into the vestibule and may there be blended, as in the bird, with the rectal excrement.'

'That the existence of a penis is essentially related to the sexual organs, and not to the renal, is singularly illustrated by the complete separation of the uro-urethral from the semino-urethral passages in monotremata.' 'The physiological relation of Cowper's glands to such a canal is clearly illustrated by their presence in the monotremes and by their absence in the oviparous animals,' such as the tortoise, 'which have only a groove.' 'If the canal of the penis were slit open along its under part, and thus converted into a groove, the male organs of the ornithorhynchus would be like those of a tortoise.'

The Urethra.—The first part of the urethra in animals includes those portions which in human anatomy are named prostatic and membranous; it comprises the whole urethra lying between the bladder and the bulb—that portion which is developed from the entodermal cloaca. It is relatively longer in animals than in man, and it can usually be seen in its entire length, when viewed from in front, to be like a long tubal extension of the bladder. It has also a continuous external coat of voluntary muscle. When viewed from behind, the urethra is partially covered by the genital organs, to which they are attached and into which they pour their secretion. These organs are the vasa deferentia, the vesiculæ seminales, the utriculus masculinus, and the prostate glands; they are all attached to the posterior and lateral surfaces, and, with the exception of the utricle, their openings on the mucous surface of the urethra are arranged symmetrically on either side of the middle line. The utricle opens in the middle line and nearest to the bladder. The orifice is sometimes open, as in the rabbit, and at other times it is closed, as in the deer and beaver. On each side of the utricle the orifices of the vasa deferentia open upon the surface; they are always in this relative position, and in such animals as have the openings of the seminal vesicles separate from those of the vasa deferentia, they are found external to or below the latter. The prostate glands always discharge their secretion into the urethra either below or external to the utricle and vasa deferentia; they have a lower position on the urethra than the other structures which have just been mentioned, and are attached at a considerable distance from the outlet of the bladder, as, for example, in the squirrel (fig. 25). In animals the prostates are never closely applied to the outlet of the bladder as in man; they are clearly seen to be distinct and separate glands, appendages of the urethra, and in no way connected to the bladder. It will be seen later that there is some evidence that this is the original condition in man.

The Utriculus Masculinus.—The utricle in animals is very unequally developed in different individuals. In some, as in the rabbit, it is a large, bi-lobed, saccular organ, lying above the prostate; in others it is bifurcated, as in the beaver (fig. 32), while in others it is very small indeed, and scarcely perceptible. In some there is no evidence of any other part of the utricle (Müllerian ducts), while in others, as in the goat (fig. 33), the cornua of the utricle are continued as far as the epididymis. It is because of its relation to the prostate that the utricle is of interest in human anatomy and pathology, but if we are to be guided in our view by comparative anatomy there does not appear to be any ground for supposing that the diseases of the human prostate are homologous with the diseases of the human uterus. If there are homologous diseases, then the homologues of diseases of the human uterus must be sought in the utriculus masculinus and not in the prostate, because it is clear that the prostates of animals are wholly distinct from the utricle, and it is equally certain that the male utricle and the female uterus and vagina are homologous organs.

Summary.—The foregoing review of the accessory genital glands, utricle, and urethra, suggests the following conclusions:

1. That the seminal vesicles, the prostate glands, and

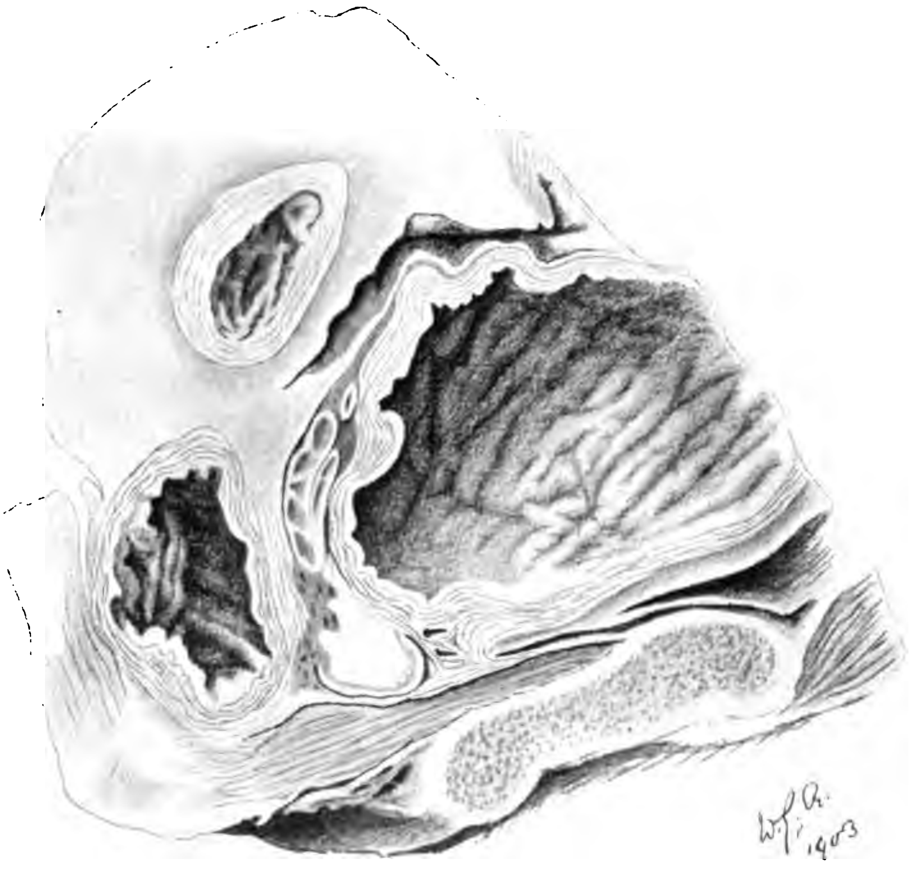

Fig. 16.

Sagittal Section of Adult Human Male Pelvis, $\frac{2}{3}$ inch to left of middle (line from specimen 8).

Cowper's glands are developed for the same purpose—namely, that of providing a mucous vehicle in which the male germ-cell can live in its passage through the genito-urinary tract.

2. That this function is carried out in different ways; either by medium development of all the accessory glands, or by relatively great development of one or two, and corresponding smallness of the others.

3. That each of the accessory glands arises in connection with a portion of the tract which has a separate embryological origin; the seminal vesicle in connection with the Wolffian duct; the prostate with the uro-genital sinus; and the Cowperian glands in connection with the penile urethra.

4. That Cowper's glands are never wholly absent, and the prostate glands very rarely so; but that the seminal vesicles are often absent, and when not developed their place is apparently taken by an enlargement of the lower end of the vas deferens.

5. That the seminal vesicles are not reservoirs for the storage of the male germ-cells.

6. That the prostate glands are two in number, one being developed from each side of the urethra.

7. That the prostrate glands have no connection with the bladder.

8. That the prostates have no connection with the utriculus masculinus, and are distinct structures.

9. That the fecundity of an animal is in proportion to the state of development of the accessory genital glands.

DEVELOPMENT.

In the course of the study of the development of the prostate it is necessary to enter more or less fully into the development of the entire genito-urinary tract; first, because the prostate is situated at the point of union of the internal genital and urinary organs, and, secondly, because the male uterus (the utriculus masculinus)—the representative of the female uterus and vagina—is embedded within the prostate. The natural inference that the common diseases incidental to cessation of sexual activity in the prostate and the uterus are homologous can only be demonstrated as true or false after a clear understanding of their development.

The subject will be taken in the following subdivisions:

1. The cloaca.
2. The Wolffian duct.
3. The Wolffian body.
4. The Müllerian duct.
5. The bladder and urethra.
6. The external genitals.
7. The seminal vesicles and Cowper's glands.
8. The prostate.
9. A summary.
10. Conclusion.

1. **The Cloaca.**—At a very early period in the development of the human embryo, the primitive groove appears (fig. 34), at the bottom of which the epiblast and the hypoblast are in contact without the intervention of the mesoblast. The neural canal and the spine are formed from a development of the blastoderm anterior to the primitive groove, around what is named the neural groove, at the sides of which the epiblast and hypoblast are separated by mesoblast. This mesoblast extends backward also on either side of the primitive groove. Beneath the neural groove the notocord is formed, and its posterior extremity reaches to the fore end of the primitive groove, where, as already stated, the epi-

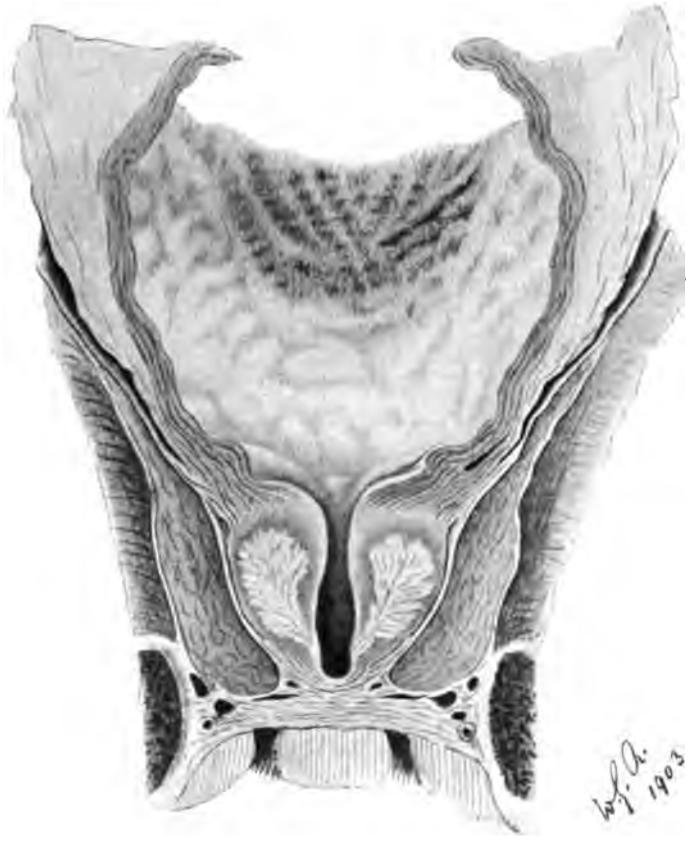

Fig. 17.

Coronal Section of Human Adult Male Pelvis through Prostatic Urethra, viewed from behind (from specimen 11).

blast and the hypoblast are in contact. After the fore end of the embryo has been marked off by the dipping down of its anterior extremity and the formation of the anterior limiting sulcus, with its extension backwards along the sides, the posterior end of the embryo also becomes depressed, and a sulcus is thus formed around the embryo. This sulcus becomes deeper and deeper until it gradually approaches the ventral surface, and thus constricts off the embryo, and causes a narrow communication between the yolk sac and the primitive intestine. This narrow communication is at the future umbilicus, and it includes the stalk of the allantois. The bending downwards of the posterior end of the embryo takes place immediately behind the end of the notocord; and the primitive groove being in the middle line of this area, it follows that the groove comes to have a direction downwards from the tail end of the embryo towards the umbilicus. While the communication between the embryo and the yolk sac is still large, the cavity of the embryo is divided into three portions: 1. The fore-gut, which is the part enclosed by the head end as far back as the posterior limit of the anterior sulcus; 2. The mid-gut, which is the part lying opposite to the wide open umbilicus; 3. The hind-gut, which is the part between the opening of the yolk sac, at the umbilicus, and the tail end.

Between the epiblast and the hypoblast there is the mesoblast, which forms a thick layer of cells arranged like a column along each side of the neural canal, but which becomes a thin layer where it spreads out laterally in the sides of the embryo. This thin layer is split into two sheets, one of which is attached to the epiblast and the other to the hypoblast; and between them there is a space—the pleuro-peritoneal cavity or cœlom—which extends from the head end to the tail end of the embryo. From the outer sheet, which is thus formed of mesoblast and epiblast, and is named the somatopleure, the body wall is developed; and from the inner sheet, which is formed of mesoblast and hypoblast, and is named the splanchnopleure, the alimentary canal is developed.

From the ventral surface of the hind gut the allantois projects as a hollow evagination which passes forwards towards the umbilicus, where it emerges from the embryo behind the umbilical stalk of the yolk sac, to form, when it reaches the chorion, the placenta. That portion of the allantois which intervenes between the surface of the embryo and the placenta forms one of the constituents of the umbilical cord; but the part within the embryo probably all atrophies.

The tail end of the embryo becomes more and more flexed until the end of the spine looks downwards and the primitive groove lies almost entirely on the ventral aspect of the body, and thus forms the ventral boundary of the hind-gut in the midline between the tail and the umbilicus. The bottom of the groove, which is formed of united epiblast and hypoblast, is named the cloacal membrane. At a very early stage of development the condition of the hind part of the embryo is as follows: above and behind there is the down-folded tail; laterally, there are the sides of the body which pass to the edges of the primitive groove; below, there is the cloacal membrane. Within there is the hind-gut, here named the cloaca.

Some time before the eighth week the cloaca becomes divided into a ventral and a dorsal part by means of a lateral partition, which grows from each side and unites with its fellow (fig. 36); the fusion taking place at the upper part first, and gradually approaching the cloacal membrane, with which it unites. The dorsal portion of the cloaca becomes the rectum, and the ventral portion becomes the genito-urinary sinus, and probably also the bladder. The blind end of the rectum is now closed by the cloacal membrane only, and the uro-genital sinus is also closed by the same membrane. The end of the cloaca is somewhat turned downwards (ventral), so that the blind uro-genital sinus is only separated from the umbilicus by the tissue in which the stalk of the allantois is embedded. This cloaca which has been described is lined by entoderm, and is named the entodermal cloaca. On the outer surface of the hind end of the embryo there is a depression, which is named the ectodermal cloaca because it is formed from the epiblast or ectoderm. This ectodermal cloaca is formed in the line of the primitive groove by an elevation of the margins of the groove, which takes place at the same time as the subdivision of the entodermal cloaca into rectal and genito-urinary portions. Behind the posterior border of the umbilicus the mesoblast of each side passes inwards to meet its fellow and to form the symphysis pubis, and to mark the anterior limit of the ectodermal cloaca. Immediately behind this ridge of tissue there is another projection which appears about the same time--the genital eminence from which the clitoris and penis are formed. At each side of the genital eminence there is a fold which is continuous in front with the fold in front of the penis and which passes backward to the integument behind the anus. About the ninth or tenth week a lateral fold passes inwards from each side in front of the anus, and, meeting its fellow from the opposite side, forms the perineum. This perineal fold on the outer surface of the cloacal membrane

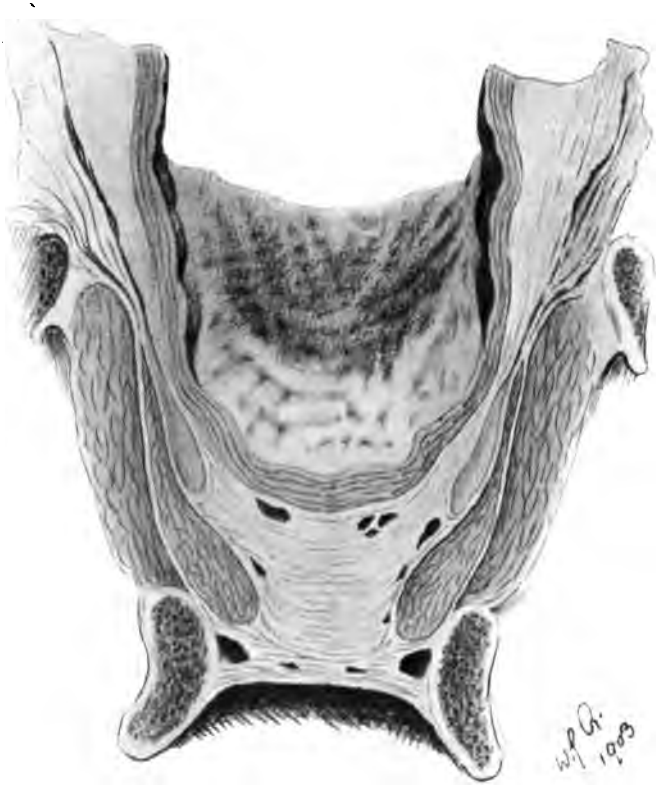

Fig. 18.

Coronal Section of Human Adult Male Pelvis immediately in front of Prostate, viewed from behind (from specimen 10).

corresponds to the fold which subdivides the entodermal cloaca, and which meets the cloacal membrane on its inner surface. It is not known at what time the cloacal membrane disappears in the human embryo, but when it does the rectum becomes continuous with the part of the ectodermal cloaca which is behind the perineum, and the anterior portion of the ectodermal cloaca becomes continuous with the genito-urinary portion. At this stage (eleventh or twelfth week) the external genitals of both sexes are the same, both being of the female type.

2. **The Wolffian Duct.**—The ridges on either side of the neural groove (fig. 34) arch over it, and meeting above the groove, they convert it into a canal—the neural or medullary canal. On each side of this canal there is a column of mesoblast cells, which column receives the name of paraxial mesoblast, and from it the skeletal muscles are mostly developed. External to the paraxial mesoblast there is another column of mesoblast, named the intermediate cell mass, which is continuous on its outer side with the somato-pleural and splanchno-pleural mesoblast and forms the inner boundary of the cœlomic cavity. It thus lies between the cœlomic cavity on its outer side and the paraxial mesoblast on its inner side, and it is beneath the epiblast.

About the fifteenth day a cord of cells appears at the back part of the intermediate cell mass and runs backwards from the fifth somite towards the tail. This cord becomes channelled during the third week, and is then known as the Wolffian duct. It runs backwards in the anterior part of its course close under the epiblast, from which it is believed, by many investigators, to spring, and towards the end of the third week it joins the anterior part of the cloaca—that part which becomes subdivided off from the rectum and is known as the uro-genital canal (fig. 36). The Wolffian duct is an exceedingly important structure. In the young embryo it forms the excretory duct for the Wolffian body, which will be presently described, and which, though a temporary organ in the human fœtus, represents the permanent kidney in fishes. The Wolffian duct ultimately forms the excretory duct of the testicle in the male, and is seen as a vestigial structure—Gärtner's duct—in the female. It also forms the lower third of the vagina in the female, and of the utriculus masculinus in the male.

3. **The Wolffian Body.**—A succession of transverse tubes are developed in the intermediate cell mass between the Wolffian duct and the cœlomic cavity. By one end these tubes or ducts communicate with the Wolffian duct at right angles, while by

the other end they join little columns of cells which pass to them from a special portion of the peritoneal epithelium known as the germinal epithelium. The growth of these transverse tubes causes the appearance of a ridge-like body at the back of the cœlomic cavity, which extends along each side of the mesentery from the fifth somite in front to near the tail end. This is the Wolffian body or mesonephros. On that surface of the Wolffian body which is nearest to the mesentery there is early developed (fifth week) a special portion of the mesothelium (germinal epithelium) which is finally developed into ova or spermatozoa, and which, in conjunction with the underlying tissue, forms what is called the genital ridge. From this ridge is developed either the testicle or the ovary, according to the sex of the fœtus; but for some time the difference between a testicle and an ovary cannot be detected. The transverse tubes of the Wolffian body undergo different changes, not only according to the sex of different fœtuses, but also according to their position in the series in each individual fœtus. In the male fœtus those tubes which are directly connected with the columns of cells which proceed from the germinal area continue to develop, and they form the vasa efferentia and coni vasculosi of the testicle; some of the tubes which lie posterior (caudal) to these undergo atrophy, and are only recognisable in the adult as the vasa aberrantia or as the paradidymis (organ of Giraldès). In the female none of the transverse tubes of the Wolffian body become so intimately united to the ovary as they do to the testicle in the male, and none advance far in development, but a number of them can be seen in the broad ligament of the adult to have the same general relation to the ovary as in the male they have to the testicle; thus there is a group which radiates from the hilum of the ovary towards the atrophied Wolffian duct (Gärtner's duct), and these are homologous with the vasa efferentia of the testes—they are named in the female the epoöphoron or parovarium; others nearer the uterus (*i.e.* caudal) are not connected with either Gärtner's duct or the ovary, and are named paroöphoron and are homologous with the paradidymis. There are other transverse tubes of the Wolffian body which are nearer the head end than any of those already described. By some authors they are believed to be remnants of the pronephros or head kidney; they are the earliest to develop and the first to atrophy, and they are represented in the female by vestigial tubes between the end of the Fallopian tube and the ovary, and on the head of the epididymis in the male, as the stalked hydatids. The Wolffian

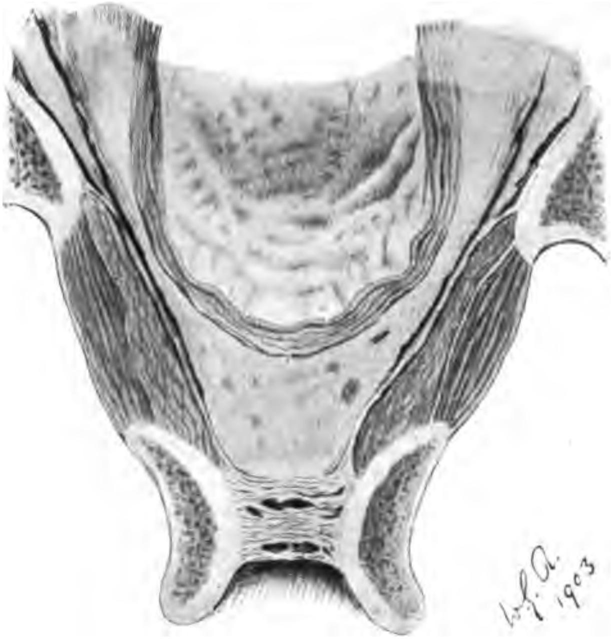

Fig. 19.

Coronal Section of Human Adult Male Pelvis at posterior edge of Symphysis Pubis (from specimen 9).

body is for the most part a temporary structure; it attains its most complete stage in the seventh or eighth week, and is then a prominent ridge at the back of the cœlomic cavity.

4. The Müllerian Duct.—The Müllerian duct is a structure of equal importance with the Wolffian duct, for just as the Wolffian duct becomes the seminal duct of the male, the Müllerian duct becomes the oviduct of the female. It makes its appearance a little later than and to the outer side of the Wolffian duct, with which it is at first parallel. There is difference of opinion as to the origin of the Müllerian duct. It is at first, that is at the upper (head) end, external to the Wolffian duct, but towards its termination it passes to the inner side and unites with its fellow of the other side in the second month. The united ducts then open into the anterior part of the entodermal cloaca between the terminations of the Wolffian ducts. In the female the whole Müllerian duct continues to develop; the anterior portion forms the Fallopian tube, with its fimbriated end, while the part which is blended with its fellow of the opposite side forms the uterus and the vagina. In the male this duct does not develop throughout, and as a rule no trace can be found of the homologue of the Fallopian tube; but occasionally there is a vestigial cord parallel with the vas deferens; this atrophied structure is continued up to the sessile hydatid of the testicle, which always exists and represents the fimbriated end of Müller's duct. Below, it is continued into the horns of the male uterus, which lies between the terminations of the Wolffian ducts at their point of entry into the urethra.

5. Bladder and Urethra.—It has been mentioned in the description of the cloaca that that structure divides into a dorsal or rectal, and a ventral or genito-urinary portion; and that the Wolffian ducts and the combined Müllerian ducts open into the ventral part of the cloaca, so that when the subdivision of the cloaca takes place these ducts are found to open into the genito-urinary portion. During the fourth week, that is before the division of the cloaca takes place, a diverticulum from the lower end of the Wolffian duct appears and grows upwards into the mesoblast, behind and to the outer side of the duct. From this duct the ureter, the pelvis, and the calices of the permanent kidney are formed (fig. 36); the tubules and stroma of the kidney probably arising from the adjacent mesoblast. As the kidney develops, the termination of the ureter alters its position and comes to have an attachment and opening in the genito-urinary portion of the cloaca, independent of the Wolffian duct from which it originally sprang.

From the genito-urinary portion of the cloaca the bladder and urethra are formed. In the male that part which is anterior to the openings of the Müllerian and Wolffian ducts develops into the bladder and upper part of the prostatic urethra; in the female it develops into the bladder and the entire urethra. The part which is posterior to the openings of the ducts in the male forms the lower part of the prostatic and the entire membranous urethra, but in the female it is represented by the vestibule. It is certain that the portion of the allantois which intervenes between the apex of the bladder and the umbilicus atrophies and becomes a solid cord about the fifth week of development; and it seems probable that this represents the entire intra-embryonic portion of the allantois. By some authorities the urinary bladder is believed to be formed entirely from the allantois; by others only the apex is thought to be so formed; while others state that the urachus is the only representative of the allantois, and that the bladder is entirely formed from the anterior (ventral) subdivision of the cloaca. After the ureter has formed an attachment of its own to the genito-urinary portion of the cloaca, it becomes more and more separated from the orifice of the Wolffian duct; not because it alters it place of attachment, but because that part of the genito-urinary canal grows rapidly, both in length and circumference, and carries the ureter away from the Wolffian duct. The intervening piece of the tube forms the trigone and base of the bladder. The ventral division of the cloaca now forms the bladder and the urethra as far as the bulb. The urethra is divided into two portions, an upper and a lower, by the openings of the Müllerian and Wolffian ducts. These two portions differ in the two sexes. The upper portion, that is the part between the bladder and the openings of the ducts, is very short in the male and forms the upper part of the prostatic urethra; whereas in the female it is long and forms the entire urethra and the adjacent part of the mucous membrane around the meatus urinarius. The lower portion, that is the part between the openings of the ducts and the penile urethra, is long in the male but very short in the female, in whom it forms the mucous membrane of the floor of the vestibule, between the posterior edge of the vagina and the fourchette behind, and between the vagina and the nymphæ at the sides.

6. **The External Genitals.**—The penis and penile urethra in the male, and the clitoris and nymphæ in the female, are developed from the genital eminence and anterior part of the ectodermal cloaca; that is, from the part in front of the perineal bar which

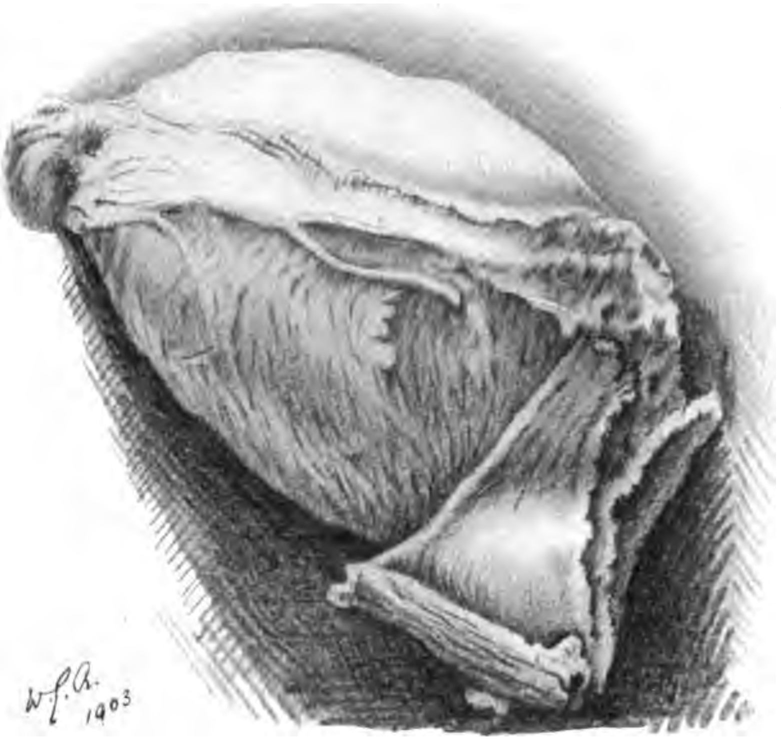

Fig. 20.

Side View of Bladder and Prostate, showing Recto-Vesical Fascia.

develops during the seventh or eighth week and divides the ectodermal cloaca into a rectal and genito-urinary portion.

If in the male the penis be laid open on its under surface from the frænum backwards through the bulb to the opening of the utricle, the external genitals will represent those of the female; and if in the female the free edges of the nymphæ be united from the fourchette forwards to the under surface of the glans, the condition of the external genitals of the male will be imitated.

In the female the uro-genital opening is surrounded by the mons veneris in front, the labia majora at the sides, and the commissure of the perineum behind; these structures are continuous internally with the cutaneous surfaces of the nymphæ. In the male there are similar folds of skin with underlying fat, on the pubes, around the base of the scrotum, and in the perineum. The finger is passed under the edge of that part of the fold which represents the mons veneris in examination of the external inguinal ring, and when such an examination is made the finger pushes the scrotum in front of it. The scrotal skin so pushed inwards is strikingly different from the pubic structures which are raised by the finger. The former differs from the latter in being devoid of subcutaneous fat and in possessing plain muscle fibres. In a full-term fœtus there is a very clearly marked, sharply defined difference between the scrotum and the surrounding skin; the scrotum being semi-transparent and wrinkled, while the surrounding skin is smooth and opaque. In a child there is a difference almost as striking between the one and the other; and even in the adult, as above mentioned, the scrotum is different from the neighbouring skin.

I would suggest that the mons veneris, the labia majora, and the commissure in the female are the respective homologues of the suprapubic integuments: of the skin which surrounds the base of the scrotum, and of the skin of the perineum in the male; and further, that the scrotum is the homologue of the nymphæ and not of the labia majora. Such a view appears to me to coincide with the anatomy of the male and female external genital organs, and to be more consistent with our knowledge of their development and of congenital malformations.

The epithelial lining of the genito-urinary passages is of interest from a developmental point of view, in that it is stratified like that of all surfaces which have an epiblastic origin. The bladder and vagina, however, are known to be developed from the hypoblast and mesoblast, and yet they are lined by stratified epithelium. It is believed that the lining epithelium of the bladder is derived from the epiblast of the ectodermal cloaca, which spreads upward and covers the surface of the viscus. The epithelial lining of the vagina, however, is believed to be derived from the ends of the Wolffian ducts. There is good ground for believing that the lower third of the vagina in the female, and of the utricle in the male, is formed by the lower ends of the Wolffian ducts. It has been mentioned that the ducts of Gärtner when present in the female are lost on the sides of the vagina, and their homologues in the male, the vasa deferentia, terminate at the orifice of the prostatic utricle. In sections of the developing uro-genital sinus at the level of the entrance of the Wolffian ducts, it can be seen that these ducts terminate in bulbous enlargements one on each side of the entrance of Müller's duct, embedded in, if not forming the termination of, that duct. The Wolffian ducts are formed originally from the epiblast, and in this way it is possible to account for the presence of stratified epithelium.

7. **The Seminal Vesicles and Cowper's Glands.**—Somewhat later than the time of the appearance of the diverticulum from which the kidney and ureter are formed, another diverticulum grows from the lower end of each Wolffian duct; it grows outward and forms the seminal vesicle, which is thus seen to be an appendage of the vas deferens (fig. 36). The common ejaculatory duct is that part of the duct of the testicle into which the seminal vesicle pours its secretion.

Cowper's glands arise as diverticula from the mucous membrane at the base of the genital eminence from which the penis is developed in the male and the clitoris in the female. They are homologous with Bartholin's glands in the female.

8. **The Prostate.**—In transverse sections at various points in the first part of the urethra, in a male fœtus, at three and a half months (fig. 37), the fibres in the urethral wall are seen to be arranged for the most part longitudinally; but there is a narrow external zone of circularly arranged fibres covering the front and sides of the section. At this stage of development the muscle fibres are short relatively to their breadth, but the nuclei are oval, and thus the direction of the fibres can be distinctly seen. Near the periphery of the section there is a distinct circular arrangement parallel with the outer limit of the urethra. This zone of circular fibres is very narrow, and abuts on a capsule which is composed of fibres arranged in a looser and more fibrillar manner, and in which there are not so many nuclei; this circular zone is most marked in front and at the sides of the section.

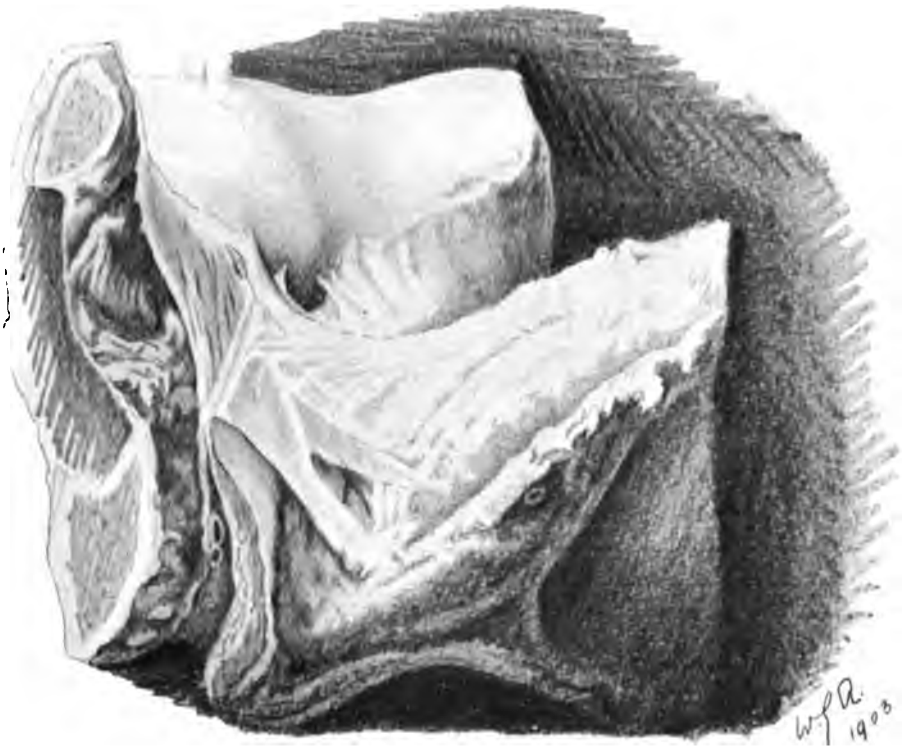

FIG. 21.

Back View of Symphysis Pubis with Bladder pulled to right, showing Fasciæ and Pubo-prostatic Ligaments and Lateral True Ligaments of the Bladder.

Internal to this circular zone all the fibres are arranged longitudinally with the exception of those which surround a small clump of gland tissue on each side of the middle line behind the urethra. This longitudinal zone forms the main mass of the wall of the urethra; its fibres are in direct contact with those of the circular zone, but there is a sharp distinction between the two layers.

The glandular portion of the prostate at this stage is small and arranged at the back of the urethra in two masses, one on each side of the middle line. These collections of gland tissue form two very distinct bodies, and there is no evidence of any gland tissue elsewhere; neither at the sides nor in front, nor behind the urethra. All the gland tissue is found farther from the bladder than the openings of the vasa deferentia. The amount and the arrangement of the gland tissue is seen in fig. 37, in which it will be observed that there are two distinct glands, one on each side. The groups of cells in each gland are large and have not as yet acquired a lumen, but there is an evident arrangement of the cells around the centre of each group, towards which point they focus. The nuclei are most abundant in the periphery of each group.

The walls of each alveolar space are formed by the muscle fibres above described as forming the longitudinal muscle of the urethra; they cannot be distinguished from the rest of the muscle except in this, that they run parallel to the wavy outline of the alveolus, forming a circular coat to each alveolus. When looking at a microscopic section of a prostate gland at this stage, the suggestion is very natural that each gland is formed by a dipping down from the urethra into the muscular wall, and that the muscle fibres arrange themselves circularly around each bud or branch of gland cells, for, although I have not found any ducts leading from the groups of gland cells direct into the urethra, yet the general course of the muscle fibres between the back part of urethra and the groups of alveoli clearly indicates their presence. If such be the case, it would further suggest that the muscular tissue of the adult prostate is derived from the urethral muscle. At this stage no other view seems possible, because sections show unmistakably that all the gland tissue is embedded in the inner, longitudinally arranged, layer of the urethral muscle wall.

In the full-term fœtus there is more gland tissue (fig. 38), and the cells within the alveoli are distinctly arranged as the lining of tubes; but although there are considerable differences between transverse sections of the urethra at 3½ and 9 months, yet the differences appear to be more of degree than of kind. The section at 9 months is more elaborate; there is more differentiation of tissues, such as the muscular and fibrous tissues, but there is the same essential arrangement. The mass of gland tissue in the older fœtus is larger and more finely developed, yet it still maintains the same relation to the urethra; the gland ducts all congregate towards the back part of the urethra. It is the peripheral portion of each mass of gland which appears to have extended its area, but while doing so it still maintains the same essential structure; it consists of glandular alveoli surrounded by involuntary muscle fibres, which are arranged parallel to the surface of each alveolus. No difference can be detected between the outlying portions of the gland and the inner portions which are within the muscle coat of the urethra, and I would suggest that the prostate glands of the older fœtus, although appearing to be two bulging masses which extend beyond the outer limits of the urethra, are merely higher developments, and that they are essentially urethral glands, probably specialised mucous glands of the urethra, which derive both their glandular and muscular elements from the urethra. There is a more interesting structure in the wall of the prostatic urethra, and that is an external layer of striated muscle fibre. This layer extends round the front and both sides of the urethra, and even on to the posterior surface as far as the position at which the prostatic gland ducts pierce the urethral wall. This layer is nearly as thick as the layer of involuntary muscle, and inasmuch as it almost completely disappears in the adult, it can only be viewed as a vestigial structure which is one of the indices to our ancestry.

9. **Summary.**—The following is a brief summary of those features of the development of the genito-urinary organs which have a bearing on our view of the anatomy of the prostate:

(1) The bladder and the prostatic and membranous portions of the urethra are developed from the ventral portion of the entodermal cloaca.

(2) The penile portion of the urethra is developed from the ectodermal cloaca.

(3) The vas deferens and the seminal vesicle are developed from the Wolffian duct.

(4) The utriculus masculinus is developed from the Müllerian duct.

(5) In the early stages of development, each embryo possesses both Wolffian and Müllerian ducts.

(6) In the later stages of development:

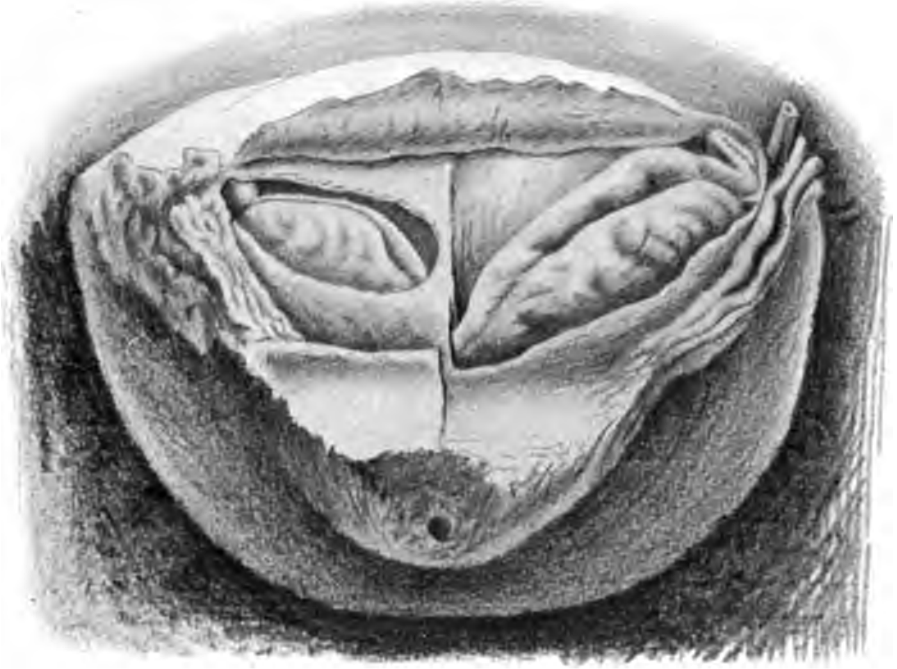

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Fig. 22.

Bladder, Prostate, Vasa, and Seminal Vesicles, viewed from below, showing Peritoneum and Vesical and Rectal Fasciæ.

(*a*) In the male, the Müllerian duct atrophies, and for the most part disappears.

(*b*) In the female, the Wolffian duct atrophies, and for the most part disappears.

(7) In both the male and the female there are vestiges of the atrophied duct, so unmistakable that there cannot be any doubt as to their identity of origin from that duct which in the other sex is fully developed.

(*a*) In the male the vestiges of the Müllerian duct are:

Müllerian duct in male	*Müllerian duct in female*
(i) The sessile hydatid of the testicle.	(i) The fimbriated extremity of Fallopian tube.
(ii) The duct of Rathke.	(ii) The Fallopian tube.
(iii) The utriculus masculinus.	(iii) The uterus and vagina.

(*b*) In the female the vestiges of the Wolffian structures are:

Wolffian structures in female	*Wolffian structures in male*
(i) The hydatid of Morgagni.	(i) The stalked hydatid of the testicle.
(ii) The parovarium (epoöphoron).	(ii) The efferent ducts of the testicle.
(iii) The paroöphoron.	(iii) Paradidymis (organ of Giraldès).
(iv) Gärtner's duct.	(iv) The vas deferens and epididymis.

(8) In the male the utriculus masculinus (the coalesced Müllerian ducts) enters the back of the first part of the urethra (the uro-genital sinus) in the middle line, and the vasa deferentia (the Wolffian ducts) terminate, in the edge of the orifice of the utricle, on either side.

In the female the vagina (the coalesced Müllerian ducts) enters the back of the vestibule (the uro-genital sinus) in the middle line, and the ducts of Gärtner (the Wolffian ducts) terminate in the lower part of the vagina on either side.

(9) The homology between the male prostatic utricle and the female uterus and vagina is a demonstrable fact.

(10) The male prostatic utricle and the female uterus and vagina have an origin distinct and different from that of the uro-genital sinus.

(11) The prostate glands are developed in the wall of the genito-urinary sinus, at a point farther from the bladder than the opening of the utricle. They are apparently mucous glands of the uro-genital sinus, and they consist, *in the fourth month*, of a few branching columns of cells which cluster together at the back of the urethra, where they are seen in two separate masses, one on each side of the middle line. At this stage they are entirely within the layer of involuntary muscle of the urethral wall, and do not form any visible projection. *In the ninth month* they are larger, more fully developed, and form visible projections; they are two separate and distinct glands, and have grown beyond the limits of the external wall of the urethra.

(12) Surrounding the major portion of the urethra, in fact the entire urethra, except the point where the gland ducts penetrate the posterior surface, there is a well-developed layer of voluntary muscle.

(13) Cowper's glands are developed in the ectodermal cloaca, in connection with the penile urethra.

10. **Conclusion.**—That the human prostate arises as two separate glands, which are developments of the lining membrane of the first part of the urethra; and that it has an entirely distinct and different origin from that of the utriculus masculinus.

Examination of the Normal Bladder and Prostate per Rectum.—Before introducing the index finger into the rectum, it should be very thoroughly smeared with soft soap, as thickly as possible, and then dipped in oil—castor oil is the best. This is an important detail, because it has the double advantage of not paining the patient (and rectal examination is a very painful proceeding), and, if the patient is comfortable, of permitting a thorough exploration. Two phalanges of the index finger can be introduced beyond the sphincter ani, and the first thing encountered by the tips of the finger is the posterior surface of the prostate. If the terminal phalanx be flexed, it will pass into a small recess in the anterior wall of the rectum, immediately above the sphincter internus, and at the bottom of the recess it will touch the back of the membranous portion of the urethra. Passing up in the middle line, the tip of the finger will feel the back of the prostate, firm and smooth, with perhaps a depression between the lateral lobes. The finger will then feel a less definite, though firm body, above the prostate; and above this the finger will touch a soft undefined substance. The firm body just mentioned is the posterior surface of the vasa deferentia and

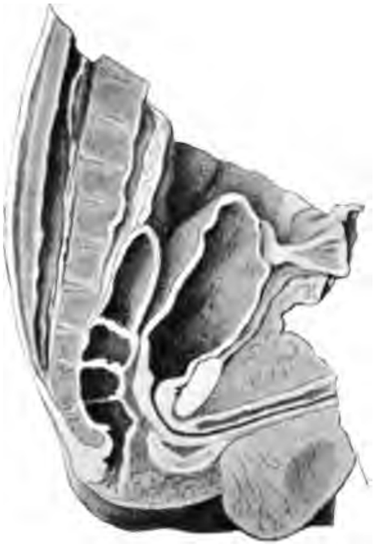

Fig. 22a.

Sagittal Section of Full Term Fœtus (specimen 13).

the vesiculæ seminales. There is no clearly defined division between the vesicles and the prostate, as might be expected when the firm fascia which passes over them from the bladder to the back of the prostate is called to mind. Above the vesicles and the vasa deferentia, the soft undefined posterior portion of the bladder can be felt, but it cannot be recognised as the bladder. The peritoneum of the recto-vesical pouch comes to within half an inch of the upper edge of the vasa deferentia. Puncture of the bladder per rectum is made in the middle line above the vasa deferentia: it is performed by guiding the curved trocar to the highest point which the finger can reach. Inasmuch as the vasa deferentia lie in contact in the middle line, and the peritoneum comes to within half an inch of them, and there is thus only left a free area of the bladder which a sixpenny-piece will cover, such an operation cannot be performed with any certainty of not doing injury either to the vasa deferentia or to the peritoneum. The trigone of the bladder cannot be palpated because of the vasa deferentia, and the seminal vesicles, which completely cover it, and are themselves covered by the firm fascia which binds them to the bladder. At the sides of the prostate, the finger passes into a little recess on each side, which marks the angle of junction of the rectal and recto-vesical fasciæ. Above these recesses on each side, the finger can reach a firm undefined mass, in which the veins from the bladder and prostate course. This mass lies immediately external to the outer border of the vesiculæ seminales, and it is pyramidal in shape, with its base towards the outer wall of the pelvis. It is bounded behind by the rectum, above by the peritoneum, in front by the bladder, and it is continuous below, with the connective tissue around the prostatic veins.

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CHRONIC ENLARGEMENT.

Chronic enlargement or hypertrophy of the prostate is an affection which arises during the declining years of virility, and which, on account of its anatomical position, causes obstruction to the outflow of urine from the bladder. It is an innocent affection of a sexual organ, but it causes serious disease of the urinary organs, and were it not for this accidental implication it would as a rule produce no symptoms.

It occasionally occurs in men below the age of fifty. This, however, does not alter the fact that most patients who complain of symptoms are older than fifty-four—usually a good deal older. The sixtieth to the sixty-fifth are the commonest years in which patients make serious complaint of symptoms due to it. It has been found in 34 per cent. of men over the age of sixty; and of that number, 15 per cent. suffered from symptoms. There cannot be any doubt that a minor degree of the same process, which in some men causes a visible enlargement, is more common than the above figures would lead one to believe, and that the majority of men over fifty years of age, while not having any palpable enlargement, show on microscopic examination those changes in the prostate which if carried far will be recognisable as enlargement. In very old men the affection is not relatively so common as in men between sixty and seventy.

No special social condition is associated with this affection. It is equally common among rich and poor, indolent and energetic, temperate and gluttonous. It is said to be uncommon among negroes, but it must be remembered that negroes do not often live to old age; and it is found also in animals.

Causes.—It is commonly believed that there are many causes for chronic enlargement of the prostate; thus, in a leading text-book it is asserted that 'there is little doubt that chronic enlargement is predisposed to by any continued source of irritation of the urinary organs, such as gonorrhœa, stricture, and hard living,' and in the same book there is the further assertion that 'if the true history of many cases of prostatic hæmorrhage

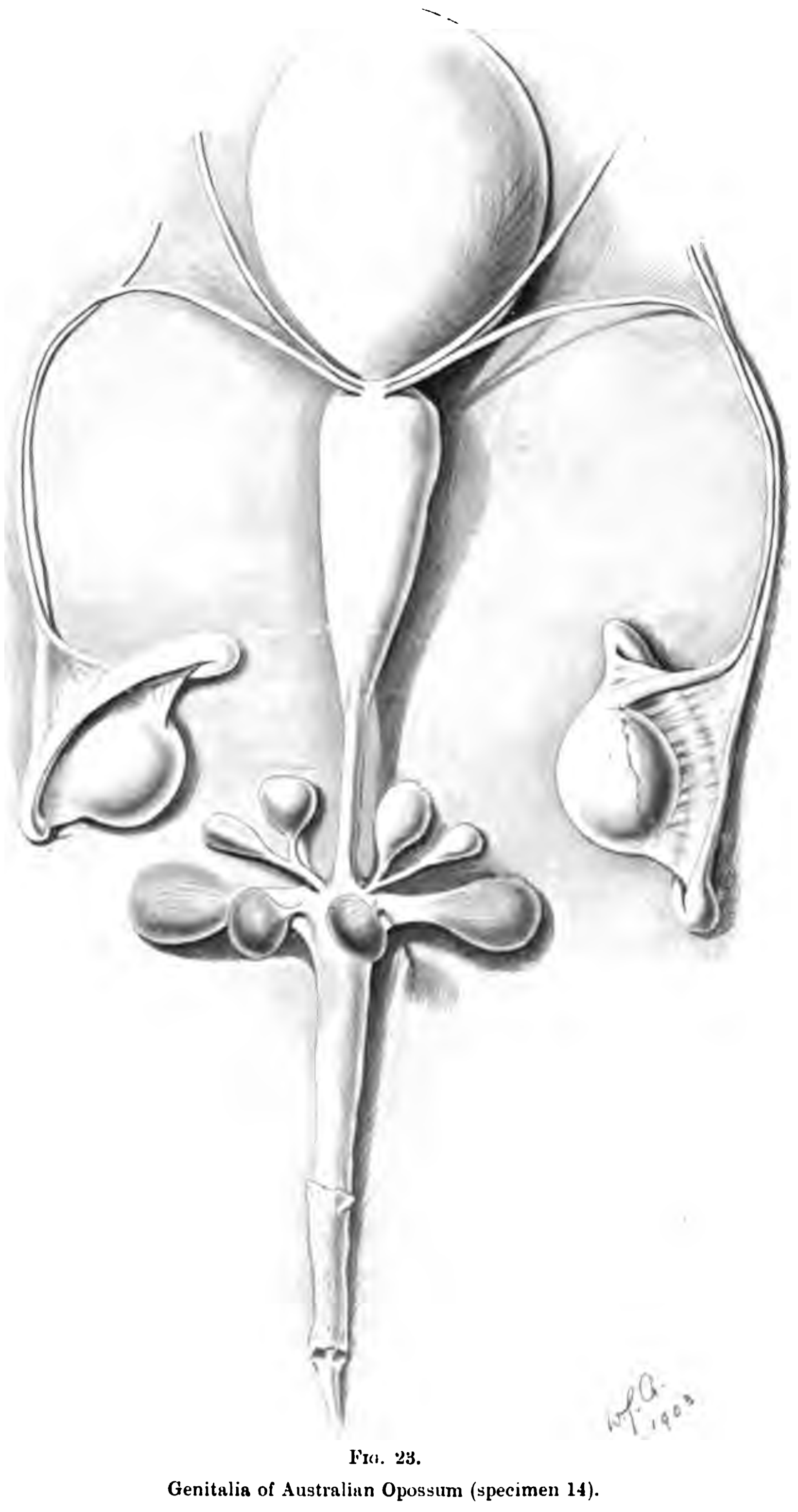

Fig. 23.

Genitalia of Australian Opossum (specimen 14).

and congestion were told, the diseases would be found to have begun in irregular sexual or erotic excitement, by which the genital organs have been over-stimulated.' This last quotation is from a section of the work which deals with the 'moral effects of enlarged prostate.' It is also asserted that 'age must be looked on as the primary cause.' That is to say, there are several dissimilar causes for this common condition of the prostate: among predisposing causes there are age, gonorrhœa, stricture, and hard living; and among exciting causes there are irregular sexual and erotic excitement. With the exception of age, I cannot find evidence to prove that any of these asserted causes are active agents in the production of chronic enlargement of the prostate. That the belief in the potency of gonorrhœa and excessive sexual excitement to cause the disease is commonly held, I am convinced, and yet there is no evidence to prove that they have any relation to it. To say that 'there is little doubt,' is to admit that there is doubt; and to say 'if the true history were told,' is to assume that the whole history has not been told, and that the prior history of gonorrhœa, or of stricture, or of sexual excess has been withheld. It were better to acknowledge that there is no evidence as to why and how chronic enlargement of the prostate takes place, and to leave the subject open for further evidence, and thus commit no positive error; but if we admit that there is doubt about the cause, and, because of the doubt, make a large assumption in order to fill the gap in the evidence, we not only confess our ignorance, but we do our patients a gross injustice. If, as occurs in numbers of patients with enlarged prostate, there is certainty that gonorrhœa, stricture, and hard living have never been present, we must, if we believe in the assertions quoted above, charge them, in our own minds, with excessive sexual excitement. This is both illogical and unjustifiable. Why *gonorrhœa* is stated to be a cause of chronic enlargement of the prostate, it is difficult to imagine. Acute inflammation of Cowper's glands, of the prostate, of the seminal vesicles, and of the testes are well-known complications of gonorrhœa, and a chronic inflammation of the same organs is known to follow the acute affection; but senile changes occurring many years after and due to the inflammation of any of these organs are not recognised. I have sought in vain for any adenomatous condition of Cowper's glands, of the seminal vesicles, or of the testes, when making post-mortem examinations upon the bodies of men who have died with, but not on account of, enlarged prostates; why, then, should gonorrhœa produce such after effects in the prostate alone? Even if senile atrophy or adenomatous change in any or all of these other organs were found, it would not necessarily make good the suggestion that such changes were due to a former inflammation, much less to a former gonorrhœa. It might with equal force be argued that adenoma of the breast was evidence of a former mastitis, and that the mastitis was secondary to lactation. The sequelæ of gonorrhœa are those of inflammation, and there is no evidence in the senile prostate to suggest that a former inflamed condition might have caused a chronic enlargement.

With regard to *stricture* as a cause of the same condition, inasmuch as stricture is a sequel of gonorrhœa, the same arguments hold good for both; with this addition in the case of stricture, namely that patients who have stricture suffer for a longer time than the ordinary subjects of gonorrhœa, and, were gonorrhœa a cause of chronic enlargement, a large proportion of old men would be found to have stricture of the urethra in addition to enlargement of the prostate. Such a combination is the exception and not the rule. In what way *hard living* should act as a cause of enlargement of the prostate, it is difficult to understand. By hard living I understand *strenuous work*; but how hard work should affect the prostate, has not been suggested. It is those who live at ease who are most apt to go to *sexual excess*, and not hard workers; but sexual excess is believed to be a potent cause of enlargement of the prostate.

It cannot be that all the above-mentioned different agencies can be causes of one and the same condition. It appears to me that the suggestion of so many causes has arisen from the hope that by finding the cause we may be led to the correct treatment. Only such causes could be suggested as are common to a large number of men; hence gonorrhœa, being a common disease of the urinary organs, might prove to have some connection with the senile enlargement of the prostate. Similarly, stricture of the urethra might possibly cause it. Inasmuch as the complaint is confined to men past the prime of life, it was natural to suggest that hard living might produce it; because the mere fact that a man lives to the age of sixty (and enlarged prostate is not usually complained of earlier) is as a rule evidence that he has by some means, probably hard work, excelled his fellows. That sexual excess should be a suggested cause is natural, but there is no evidence that it is a real cause; on the contrary, when so large a proportion of men as 34 per cent. suffer, the condition becomes almost normal, and if normal then it ceases to be excess. There

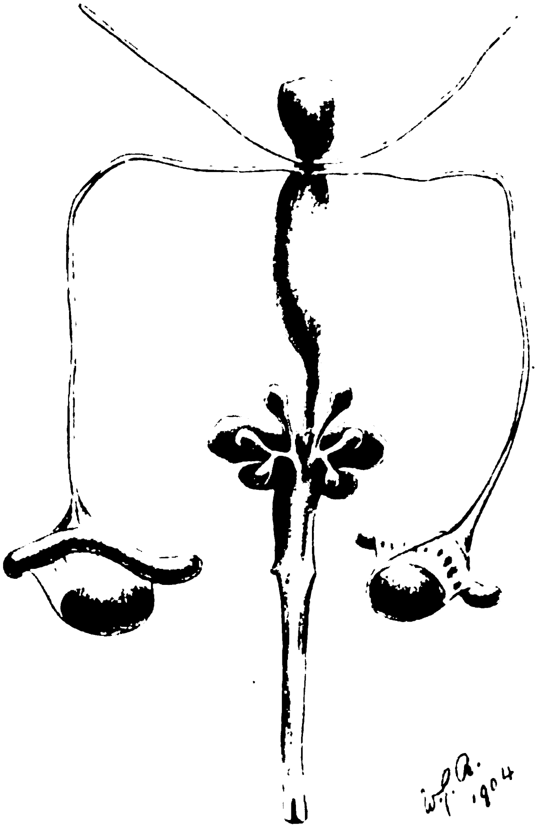

Fig. 24.

Genitalia of Small American Opossum (specimen 16).

is only one factor common to all cases of enlarged prostate, and that is *age*. This appears to me to be a sufficient cause in itself for the condition known as chronic enlargement of the prostate.

The frequent occurrence of this complaint in men past the prime of life is known to all; but the freedom from disease up to the age of fifty is equally striking, if we exclude diseases, such as gonorrhœal prostatitis and tubercle, which are secondary to the same complaint in adjacent tissues. The cause of this freedom during the first half of adult life is to be found in natural selection. The prostate undoubtedly performs some important function in association with the testes, and no individuals with diseased prostates would propagate their kind, so that reproduction of those with diseased prostates must be checked by natural selection. This must take effect during the virile period of the life of the male, both in man and animals. After the virile period no such check can be effective. It is conceivable that the disease called chronic enlargement may become more common, or even so common that all males should suffer from it. Nature takes no interest in the individual after he has passed the age of fertility. Thus animals do not wantonly kill the younger members of their own species, but as soon as the young males grow to the age of fertility they have to fight for their existence; their strength and vigour are at the maximum, so that they may hold their own among their fellows, and as soon as their strength begins to decline at the end of their period of virility, they are killed or starved by their fellows. There are no old wild animals. The only animals which grow to old age are such as man has domesticated, and which he allows to live when they have ceased to be of use, because of his affection for them. Dogs suffer from senile enlargement of the prostate; specimen 27 was taken from a very old dog, about whose history I could not obtain any information. Before dissecting the urinary organs of animals I inject the bladder with formalin (10 per cent. solution) up to the size proportionate to the size of the animal; in dogs the bladder easily distends, and the prostatic urethra is found to be dilated, when a cross section is made after hardening. In the case of the dog from which the above specimen was removed, I was unable to distend the bladder to a proportionate size; but the walls felt tense. On section the bladder was found to be very much hypertrophied and the urethra closed. The virility of an animal is greatest in the earlier part of its adult life, and it is conceivable that disease of the prostate during the later part may be aided by natural selection, which would thus prevent the propagation of weak individuals, such as the offspring of older animals.

It is held by many that enlargement of the prostate, and all the changes in the bladder, ureters, and kidneys, which are associated with it, are due to senile degeneration of the arteries, which in its turn produces sclerosis of the tissues of the entire genito-urinary tract; and that this is merely part of a general condition associated with old age. This theory cannot account for a large number, the majority, of cases of chronic enlargement, inasmuch as the affection has been shown to be one which is not common in very old men, but rather among men who have just passed middle age. In the early stages there is no disease of the rest of the genito-urinary tract, but merely hypertrophy of the bladder. It is only when the enlargement has lasted some time, perhaps years, that fibrotic changes in the bladder wall are found, and later still that equally advanced disease of the ureters and kidneys follows. Then, too, the early changes in the process of chronic enlargement are not those associated with degeneration of arteries. The first stage is that of glandular overgrowth and not that of fibrosis; and, if the glandular growth does not cause serious mechanical difficulty of micturition, no disease of the urinary organs may follow. If this theory were correct, improvement after operations for the removal of the obstruction could not follow, but this is contrary to what has been proved to be the case. An over-distended bladder which has been apparently ruined is capable of great improvement, even of complete recovery.

It has been shown that the prostate of the male is not the homologue of the female uterus, but there appears to be an analogy between chronic enlargement of the prostate and myomata of the uterus. Both organs are essential to reproduction, and during the earlier part of fertile life are remarkably free from disease, but during the declining years of fertile life, both are specially apt to be affected by innocent irregular growth of their essential tissues.

A strictly homologous tumour to that of a uterine myoma would be a tumour of the prostatic utricle. Such a tumour has not been found. The tumour of the uterus is a myoma from the beginning. The tumour of the prostate is a glandular tumour at its commencement, and it then contains very little involuntary muscle; the changes which occur in it during the later years of its existence are due to degeneration of the glandular, and to increase of the fibrous more than the muscular, tissue.

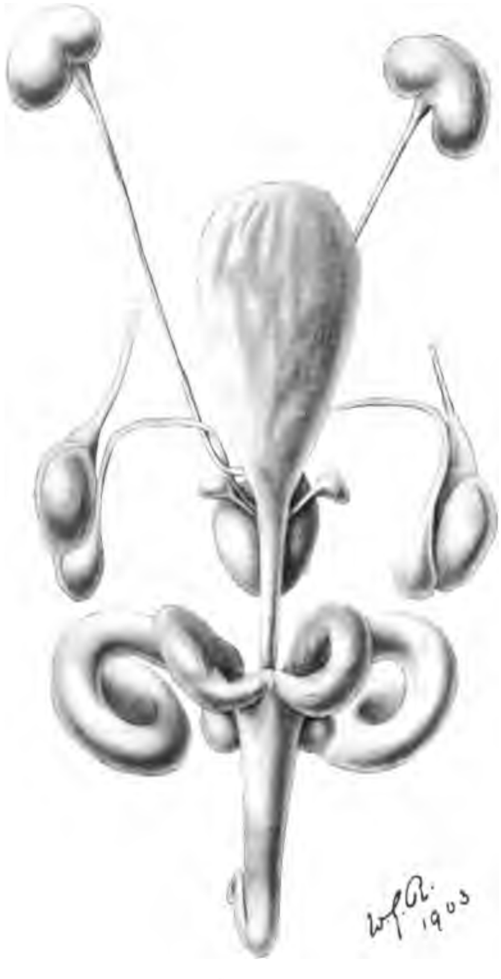

FIG. 25.

Genitalia of Squirrel, showing small size of Seminal Vesicles and great size of Cowper's Glands (specimen 17).

It has been suggested that the enlargement of the prostate is secondary to the changes occurring in the bladder in association with old age; that the bladder loses its support in old men and 'sinks lower within the pelvis, relatively to the prostate, so as to offer some difficulty in expelling the last portion of the urine.' This leads to the formation of a pouch behind a strong bar of muscle reaching from one ureter to the other, and to hypertrophy of the muscular element in the prostate, which again causes the projection of the prostate into the bladder. Against this suggestion is the fact that enlargement of the prostate does not begin in feeble old men, but in men who are often looked upon as being robust. There are also the further facts, that there is not always evidence of a pouched condition of the bladder, even when the prostate is much enlarged; and that enlargement of the prostate is found in dogs, in which animals the bladder cannot be supposed to sink in the pelvis, this latter feature being incidental to the erect position of man.

Chronic enlargement may, it is true, occur in comparatively young men, but such cases are extremely uncommon. It may be said truthfully that it is a disease of the declining years—not of very old age, but of the later years of virility. It is so common that about one in every three men above the age of sixty shows some evidence of its existence, although only a proportion of these may actually suffer any inconvenience from it. The estimate of 33 per cent. was made after the examination of a large number of prostates. There is a considerable difference between the normal weight and that which was taken as the standard above which the prostate was said to be enlarged, and it is not too great an assumption to make that all those prostates which, though not reaching the standard, are yet above the normal weight, represent minor degrees of enlargement: that is to say, there are many more prostates with senile change than is supposed. When the amount of change is very small it is not recognisable by such a gross test as that of weight, and a prostate which is only in the early stage of enlargement should not be classed among normal glands merely because the growth has not advanced so far as to be estimated in scales. Pathologically, all prostates which show any alteration in structure of the same nature as that which is known as chronic enlargement must be included in one class, no matter whether the amount of the change be trifling or excessive. If such a test be applied, it will largely increase the percentage of men whose prostates are affected, though the alteration from normal may not amount to definite enlargement. This is so evident, that in studying the microscopic anatomy of normal prostates one has to be careful to avoid sections from the prostates of men over the age of forty. My own belief is that adenomatous change in the prostate during the declining years of life is the normal sequence, for one can rarely find the prostates of elderly men of the same uniform appearance as the prostates of young adults. The marked freedom from disease of the prostate in young adults has been mentioned and accounted for by natural selection, and it has also been suggested that natural selection cannot affect, in the direction of reducing the diseases, the prostates of older men. Even though it were a rapidly fatal affection, yet natural selection could not tend to diminish its frequency, inasmuch as the subject of the disease had already reproduced his kind, and his progeny carry with them the hereditary tendency. It is the same in the case of the innocent change, which when in excess is named hypertrophy of the prostate. The subject of it has already reproduced his kind, and has handed down the tendency to his offspring, with as much certainty as he has transmitted any other feature. This change in the prostate appears to be as common as grey hairs. It is not a disease process. It is, I believe, a normal process, and can only be accounted pathological when it offers some mechanical obstruction to micturition.

Symptoms.—Enlargement of the prostate, if it does not implicate the urinary organs, produces, as a rule, no symptoms.

When the urinary system is implicated, then the symptoms may vary from a very trifling inconvenience to the most serious and painful affection. The symptoms are usually very slow in developing, occupying years. It may have no influence on the patient's general health, and it does not follow of necessity that a patient who shows early symptoms of enlargement will steadily develop those symptoms. Many patients continue with mild evidences of enlarged prostate for years, during which they suffer slight inconvenience, but no serious harm. As a rule, however, when a man shows symptoms, he slowly but steadily develops more, or those of which he complains become more pronounced. The earliest symptoms are in relation to the act of micturition. The patient finds that he takes a little longer time to empty his bladder; but no great inconvenience arises from this. He then makes an effort to pass his water more quickly, but finds that no increase takes place in the rapidity of the stream; it is as wide as formerly, or nearly so, but it cannot be projected so far. After the completion of the act the patient finds that a little urine—it may be a few drops—passes without his knowledge.

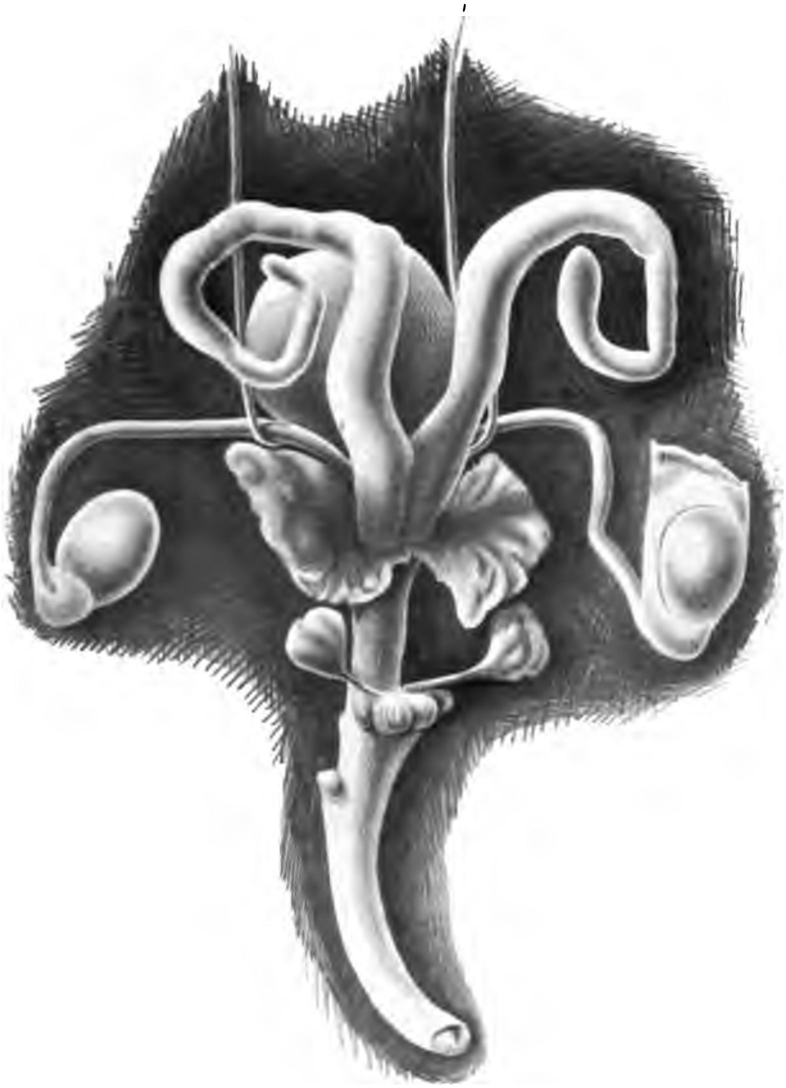

FIG. 26.

Genitalia of Guinea-pig, showing great size of Seminal Vesicles and relatively small size of Cowper's Glands (specimen 19).

This state of things may continue for years, and the patient notices them, but they do not trouble him. Later, he finds that he has to pass his water during the night: at first perhaps only after having taken alcohol in some form, but later he has to get out of bed at least once every night. There is also slightly increased frequency of micturition during the day. Up to this stage the urine is normal and the general health is good. There is no pain associated with the condition, and the patient believes himself to be well. These early symptoms are indications of slight mechanical obstruction to the outflow of urine, and of congestion at the outlet of the bladder, and they foreshadow what the later symptoms will be when the obstruction and congestion increase.

Frequency of micturition is increased, in the early stages of prostatic enlargement, on account of the congested and irritable condition of the neck of the bladder. In the later stages of the complaint it may be due to over-distension of the bladder. The greater part of the mucous membrane of the normal bladder is comparatively insensitive, and will tolerate much irritation, such as is produced by a calculus, without the desire to micturate being excited; but the outlet of the bladder, the mucous membrane around the urethral orifice, is extremely sensitive, and will not tolerate any unusual stimulation without at once causing the bladder to contract. This portion of the mucous membrane at the outlet is always more or less congested in the subjects of chronic enlargement, and the mere contact of urine is sufficient to cause an increased frequency in the calls to micturate. When the congestion is trifling, the patient finds that he passes his water a few times oftener a day than he was accustomed to do; he may not even notice this, but he does notice that he has to get out of bed at night to pass his water. Some nights he does not rise from bed, but if he has had any unusual diet, or has taken alcoholic drinks during the previous evening, he always arises once or twice. By degrees he finds that fatigue, constipation, and anything which can produce congestion in the pelvis, acts in the same way, until he never passes a night without being disturbed. These symptoms increase gradually, and he finds that he must respond at once to the call to urinate. The frequency of micturition is naturally noticed more during the night than during the day, but it is usual to find that it is not only nocturnal. So long as the calls are not excessively frequent, the general health does not suffer; but when, as is usually the case, the patient has to rise many times during each night, he begins to show the effects of loss of sleep. He looks tired, and grows older-looking rather rapidly. When the increased frequency is only due to a congested and sensitive condition of the outlet of the bladder, it is subject to a good deal of variation, according to the general health of the patient, and to diet, fatigue, and constipation; but it is usually associated with other conditions, the chief of which is mechanical obstruction to the outflow of urine from the bladder. This occurs in most patients, and it affects the frequency of micturition by causing the patient to use more force in expelling the urine—to strain—and the straining causes more congestion at the outlet, and so increased irritability. For some time, if the mechanical obstruction is not complete, the patient continues to empty his bladder, because the muscular walls become hypertrophied, and the compensation may be sufficient. In course of time, however, the bladder becomes unable to empty itself, the muscular wall is not equal to the work which it is called upon to do, and a little urine is always left in the bladder, even though the patient believes that he has evacuated it. The quantity of this residual urine gradually increases, and as it increases, so does the frequency of micturition. If the bladder, which previously held half a pint of urine comfortably, fails to expel the last few ounces, it will be quickly filled up to the half-pint again, and the interval between the calls to micturate will grow less; and if it continues to retain more and more, it will tolerate less and less addition to the residual urine, and so the frequency will go on increasing. This process takes place in many cases of enlarged prostate; and coincident with it, the bladder becomes more and more distended as the muscular wall becomes less able to act efficiently. The distension may become so great that the bladder will only tolerate a minute addition to its contained urine, and the patient has incessant calls to micturate. The bladder contracts and expels the added quantity, but the muscle quickly tires, and micturition ceases after an ounce or two of urine has been passed; the patient believing that he has emptied his bladder, whereas there may be a great quantity retained. This state of things may go on for a long time until the patient becomes worn out by lack of sleep, the frequency of micturition being every half-hour, or even every ten minutes. In some cases frequency of micturition passes gradually into incontinence of urine. This is complained of as occurring at night, and is always (except in the rare cases in which enlargement of the prostate is associated with nerve disease) due to an overfull bladder. During

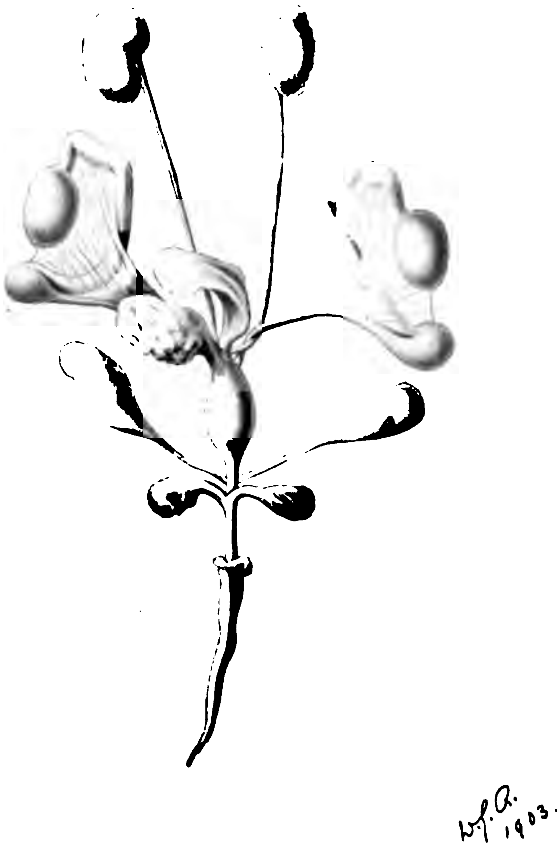

Fig. 27.

Genitalia of Mole in April (specimen 22).

the day such a patient can prevent the overflow from the bladder by voluntary contraction of the constrictor urethræ muscle, but during sleep in the night voluntary control is lost and the urine dribbles away, the patient complaining that he finds his bed wet. During the day such a patient has trouble from the fact that he cannot control his bladder. If he coughs or exerts himself in any way, a little urine passes and wets his clothing. It is always found that the cause of such supposed incontinence is an overfull bladder, of which the muscular wall has lost all power.

Pain as a symptom of enlargement of the prostate is not a common symptom, unless the affection is accompanied by vesical calculus or cystitis. The pain of uncomplicated prostatic enlargement is that of extreme desire to pass water, which may be felt as a burning sensation which is radiated to the perineum and back of the thighs. When cystitis is present, pain may be very severe on account of abrasions of the epithelial lining of the outlet of the bladder, which cause raw surfaces that are irritated by the contraction of the underlying muscle. When enlargement of the prostate is associated with vesical calculus, the symptoms of the two complaints are combined, and pain is a marked feature; in many cases those due to the calculus overshadowing the symptoms of enlarged prostate.

The character of the stream in cases of enlargement of the prostate is a prominent symptom. The patient finds that it is not so energetic as it used to be. Any effort to project the urine far is ineffectual; sometimes the effort has the opposite effect, and rather retards than accelerates the flow. It is apparently due to the same cause as is seen when an ordinary garden hose is nipped by the finger and thumb about six or eight inches from the end; in such a case the water flows in a continuous full stream, but without any energy, from the end of the hose and it drops straight down. The projection of the stream depends upon the tightness of the constriction. In cases of enlarged prostate the stream of urine is fairly energetic at the beginning of the act, but it soon fails; and though it is not projected so far, yet it continues to be of nearly the same width. This failure is due to tiring of the muscular wall of the bladder, which shows itself in the symptom so commonly complained of by these patients, namely, that when they believe they have emptied the bladder, and have sat down for a few minutes, they can begin the act of micturition again, and pass as much urine as before. Tiredness of the bladder is the usual cause of this interruption of the stream;

but occasionally it is due to a valvular action of some projecting tumour of the prostate or to a calculus. In the former case the interruption is rather sudden, and in this differs from the gradual cessation due to tiredness alone; and in the latter case the stoppage is not only sudden, but is accompanied by acute pain.

There is generally some hesitation at the beginning of micturition. The patient waits a few moments before the stream begins. This is apparently due to the enlargement, which throws the muscles about the neck of the bladder out of gear, and causes them to act at a disadvantage. In normal micturition the longitudinal fibres under the mucous membrane cause the entrance of the urethra to assume a funnel shape, and thus to allow the urine to enter the first part of the urethra and so start the act; but when the prostate is enlarged, this action of the longitudinal muscle is prevented, and so there is delay at the beginning of the act.

The character of the urine varies greatly in cases of enlargement of the prostate. When the affection of the prostate begins, the urine is healthy and the kidneys therefore are healthy, and this state of things may continue for a long time, in spite of the fact that the enlargement of the prostate is gradually increasing. In course of time, however, even though no cystitis occur, the urine will be found to undergo change. The specific gravity becomes lower and the colour becomes paler. A larger quantity is passed in the course of twenty-four hours, and the amount of urea diminishes. No casts are found, and there is no deposit when the urine is allowed to stand in a conical glass. If there is much congestion of the mucous membrane of the bladder, a deposit will be found in the urine composed of epithelial cells and débris, possibly mixed with blood cells; the congestion of the mucous lining causing the shedding of epithelium and minute hæmorrhages. If cystitis be present, the urine contains pus cells in addition to epithelium and blood corpuscles; these may be present in large or small amount. If, however, there is ammoniacal decomposition of the urine, there is a large deposit which has unmistakable characters. The urine is alkaline, and may have an exceedingly foul odour. The deposit sticks to the side of the receptacle, and is blood-tinged; under the microscope it is found to contain crystals of phosphates, pus cells, blood corpuscles, and epithelial cells. There may be no casts from the renal tubules.

Per Rectum.—Much may be learned by rectal examination in cases of enlarged prostate, but I think that many of the features

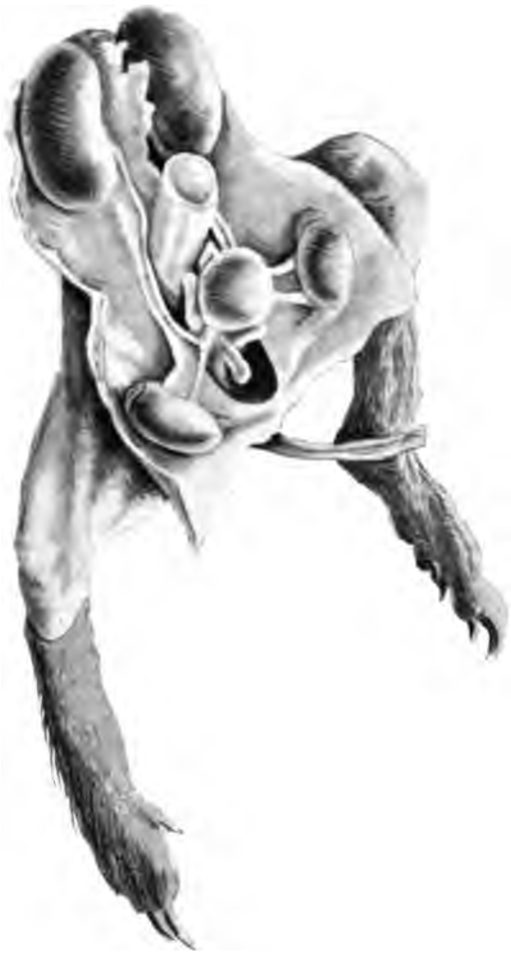

Fig. 28.

Genitalia of Hedgehog in February (specimen 21).

which are believed to be recognised during such an examination are really ascertained by other means. I have tried to distinguish the various parts which are said to be felt per rectum, and have never been able to satisfy myself that the vesical trigone or an enlarged middle lobe can be palpated. Palpation of the normal prostate per rectum has already been described. Before making the examination in a case of suspected enlargement of the prostate, it is best to pass a hollow metal sound, and to draw off most of the urine that is in the bladder. The sound in the urethra is a necessary landmark, and the withdrawal of the urine removes a source of fallacy. When the bladder is much distended the prostate is depressed in the pelvis, and it feels, per rectum, as though it were enlarged; indeed, if it is a very hard prostate, it will feel as though it were of great size. With the sound in the urethra, the finger in the rectum can always feel the urethra at the apex of the prostate. Above this point the amount of enlargement can be fairly accurately ascertained, if it be behind the urethra; the finger may have to be passed towards the coccyx in order to get past the projecting prostate: that it is a projection of the prostate is made clear by the deep sulcus on each side into which the finger can be pressed. If the enlargement be not immediately behind the urethra, but chiefly of the lateral lobes, this is ascertained at the same time. If the obstructing mass or masses are chiefly or entirely around the vesical orifice of the urethra, they cannot be accurately palpated except occasionally. If there is a large tumour of the middle lobe, which projects as much into the urethra as into the bladder, it can be palpated to this extent that a mass can be felt, but what that mass may be has to be ascertained by reference to the symptoms and to urethral examination. A small pedunculated growth from the middle lobe, or a small sessile middle lobe, I have never been able to palpate. Palpation of the enlarged prostate, if there is no inflammation of the urethra, nor excessive congestion or thrombosis of the prostatic veins, does not cause pain more than in any rectal examination; but if the neck of the bladder or the urethra is inflamed, pressure of the finger is very painful. So also is a congested or thrombosed condition of the veins of the prostate; in such a case there is some very tender swelling to be felt at the upper part of the prostate, and more to the sides than in the middle line.

Per Urethram.—More may be ascertained as to the condition of the prostate than by examination per rectum. Information is gained by inspection with a cystoscope, by touch with a sound, and by examination of the contents of the bladder withdrawn through a catheter. The precautions to be observed before passing any of these instruments into the urethra will be given in detail in connection with the treatment of enlargement of the prostate. The cystoscope is not an essential instrument in the diagnosis of enlargement of the prostate, although on occasion it is of use. The employment of the cystoscope has the disadvantage that it requires a somewhat prolonged and trying examination, which it is desirable to avoid in most cases of enlargement of the prostate. By its use small outgrowths from the middle lobe may be seen, also saccules of the bladder wall, and, most important, the presence of calculi encysted in saccules; these latter being likely to escape detection with a sound alone.

The catheter is the most important instrument, for, although enlargement of the prostate may be suspected or its existence even be certain, yet the kind of obstruction and the condition of the bladder are never certain until a catheter has been passed. When this part of the examination is about to be undertaken, a catheter of a fair size—No. 8 or 9 English scale—should be selected, because, inasmuch as the prostatic urethra is always enlarged in these cases, there cannot be any objection to using an instrument of good size; and because the beak of a small instrument is likely to be arrested by irregularities past which a larger one will easily glide. A soft india-rubber catheter should be first tried, and in the majority of cases it will pass into the bladder without difficulty. Before passing the catheter the patient should be seen to pass his water; when he has completed the act, the catheter should then be inserted. Three things are then discovered: first, the presence or absence of obstruction to the ingress of the catheter; second, the amount of residual urine; and third, the condition of the bladder. The last point, the condition of the bladder, is revealed in two ways: first, by the character of the stream which issues from the catheter; and second, by examination of the urine so passed. Before the catheter enters the bladder some information is gained. It may be that an india-rubber catheter will not pass at all; in which case it is withdrawn, and a rather more rigid instrument is used, such as an English gum-elastic or a silk catheter of the same size. If this fails, a coudée or bicoudée catheter may be tried; and if this succeeds when the former instruments have failed, the inference is drawn that there is some sharply projecting tumour in the urethra which presents too sharp an angle with the urethra for the straighter catheter, while the coudée can surmount it.

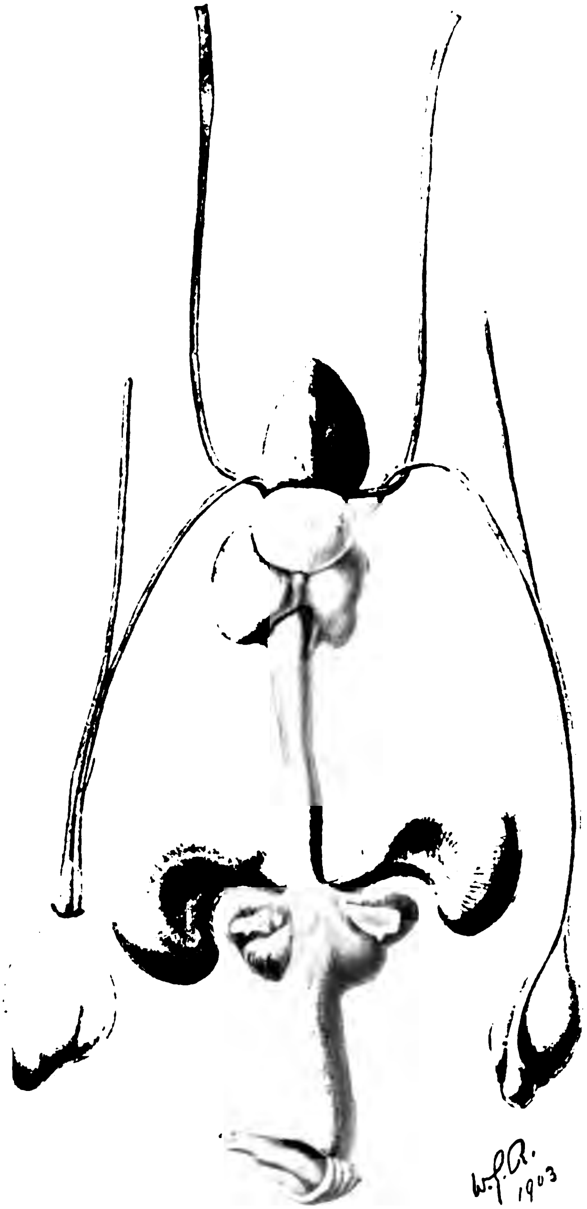

Fig. 29.

Genitalia of Civet Cat, showing absence of Seminal Vesicles and large size of Cowper's Gland (specimen 24).

If it is known in which way the beak of the coudée catheter is presenting, then the position of the tumour can be ascertained. Such a cause of obstruction to the catheter is usually to be found on the posterior surface of the urethra near the outlet of the bladder; though it may be due to a projecting lateral lobe. If a coudée catheter will not pass, it will be necessary to use a metal instrument; and if this passes when the other various forms of soft instruments have failed, the inference is drawn that the cause of the obstruction was not due to any specially prominent tumour in the urethra, but to swelling of the mucous membrane. It frequently happens that none of these instruments will pass into the bladder, in which case it is necessary to use a prostatic catheter, which is a long instrument with a bigger curve than the ordinary metal catheter, and whereas the ordinary instrument is one-quarter of a circle the prostatic catheter has a curve one-third of a circle. If this enters the bladder when all the others have failed, it suggests that there is either a tumour of the posterior wall of the urethra close to the bladder or a collar-like projection of the back edge of the internal meatus, with congestion of the mucous membrane as well. When passing a catheter it is often noticed that almost the entire instrument has to enter the penis before any urine is withdrawn; this is due to the elongation of the urethra which nearly always exists. Accurate measurement of the length of the prostatic urethra cannot be made by merely noting the distance which the external meatus slides along the catheter, because the penis is itself apt to vary when an instrument is passed along the urethra; but it is sufficient to show when the elongation of the prostatic urethra is excessive. When this is found to be the case, the inference is made that there is considerable projection of the prostate into the bladder. Another estimate of the length of the urethra is formed when a prostatic catheter is used; in such cases it is found that the handle of the instrument has to be depressed between the legs of the patient before urine flows, and the inference is then made that there is great elongation of the posterior wall of the urethra with a prominent overhanging posterior margin to the internal meatus, causing the first part of the urethra to pass downwards and backwards instead of vertically downwards as in the normal condition. Another feature of the prostate is also ascertained when the catheter is passing, and before it enters the bladder. It is sometimes found that a little urine flows, and that it then stops or merely drips, but if the instrument be passed farther and enters the bladder a good stream begins. This is due to dilatation of the prostatic urethra, which is capable of holding many drachms, even some ounces, of urine; and it is apt to deceive one if the fact is not borne in mind. A short-beaked sound is also used for examining the prostatic urethra and the bladder, and also in conjunction with digital examination per rectum. In examining the urethra the sound reveals irregularities caused by tumours pressing into the urethra, and, if there be much dilatation, the beak of the sound may have some play—may even be rotated—if the beak is short. Marked deviation of the shaft of the sound to one side or the other indicates on which side the enlargement is greatest. When the sound has entered the bladder calculi are searched for in the usual manner, but they may lie in a deep post-prostatic pouch and so escape detection, as may also calculi in any saccule. By combined examination with a sound in the bladder and the finger in the rectum, tumours of the prostate can be palpated and an accurate picture of their size and position formed. Isolated small growths of the middle lobe, however, cannot be accurately palpated, their presence being inferred from the symptoms and from the absence of other forms of obstruction.

The amount of residual urine in the bladder is of great importance. If it be small it is evidence either that the obstruction is not great, or that the bladder has hypertrophied sufficiently to nearly overcome it; but although this is true, yet the fact that there is any residual urine points out that there is some obstruction, and that the compensative hypertrophy is not complete. When once there is even a small quantity, it tends to increase. When it is in great amount the bladder has usually lost almost all power to contract, and after the first rush of urine through the catheter, the stream slackens and then rises and falls with the respiratory movements of the patient. This is evidence that the muscle wall of the bladder has failed—at any rate for a time. The character of the urine has been already referred to, but there is one feature of it which is occasionally seen during examination with the catheter, namely that the naked eye appearance varies. It is usual to find the last urine muddy when there is cystitis; but sometimes the urine which is passing is clear, and then the stream becomes muddy and then again it clears: this suggests that the muddy portion of the stream represents the contents of a sacculus which has emptied itself.

Pathology.—The terms chronic enlargement and hypertrophy are used to denote those changes which give rise to definite increase in size of the prostate. 'Chronic enlargement' conveys no idea of the structural changes in the gland; and 'hypertrophy'

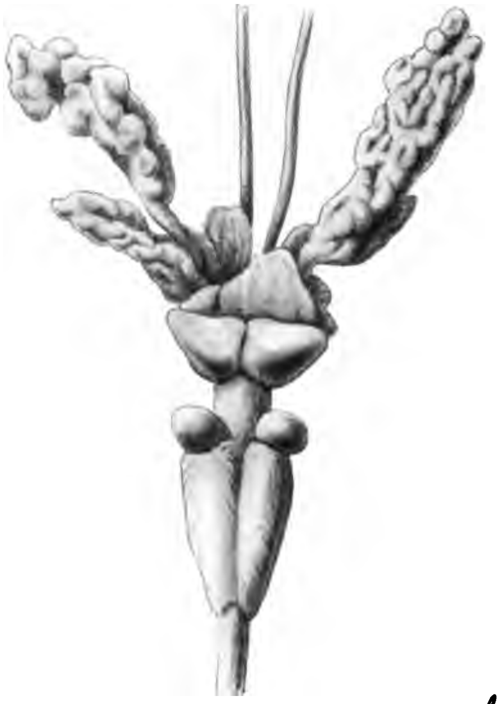

Fig. 30.

Genitalia of Large Black Ape, showing the Likeness to Human Organs (specimen 25).

is known to be an incorrect description. The former is a very useful clinical term, but it suggests that the essential feature of the changes which take place in the prostates of elderly men is the increase in size, whereas these changes may take place in a minor degree and produce no gross enlargement. It is true that elderly men do not complain of symptoms due to the change unless it has advanced to such a degree as to produce visible increase in bulk, and therefore enlargement, greater or less, is always present in those who seek advice, so that clinically chronic enlargement is a correct term; but if the prostates of elderly men who have not had any symptoms, and whose prostates are not visibly enlarged, be examined microscopically, it will be found that there are areas in the section which show the same changes, in a lesser degree, as those which are characteristic of the enlarged prostate. I have already suggested that the alteration in structure is normal to the prostate in the declining years of virility; and I would further suggest that every stage can be recognised, from an alteration in the structure of a minute area to the largest tumour. The name 'hypertrophy' arose from the observation that the structure of a uniformly enlarged prostate is essentially the same as that of the normal gland; but there is this difficulty in accepting such a term, namely that the increase in size does not appear at the time when the prostate is most active. Hypertrophy of an organ is the evidence of its response to a call for increased work. If the enlargement were a true hypertrophy it would occur during the years of sexual activity, but it is known to occur during the years when such activity is declining. There is also the fact that although the structure of the enlarged and of the normal prostate is essentially the same, yet there is a recognisable difference between the two.

If the apparently normal prostate of a man between fifty and sixty years of age be examined under the microscope, much of the gland will be found to be normal, but here and there small areas will be found in which the cross and longitudinal sections of the tubules are larger than normal. Some of the tubules are much distended, and the walls are lined with cells which are not arranged in the same uniform manner as in a normal gland; they are heaped up in several layers in one part, and there is only a single layer in others. The wall of the tubule is normal. The lumen is occupied by granular débris and detached cells. Such a condition may be found here and there in the prostate removed post-mortem from any elderly man, and it is not associated with any increase in bulk; there is no hypertrophy. The structure of a uniformly enlarged prostate is the same as that just described, the only difference being this, that in the latter the process has not advanced far, whereas in the former a large part, perhaps the whole of the organ, has become affected. It appears to be the first stage in the degeneration of the prostate in declining years. Sooner or later the stroma of the organ takes a more conspicuous share in the change. The fibrous and muscular tissues become increased in amount, and this increase may become so large that the gland tubules are compressed and can then only be recognised as fissures, lined by gland epithelium, among the fibrous and muscular tissues. The size which the prostate may attain depends upon the extent to which this process may be carried. In some, the majority, it does not proceed farther than an alteration in the existing tubules, while in others there appears to be an increase in the number of tubules. Whether these are newly formed or only diverticula of those which already exist, is not apparent. If they are new independently formed tubules, they must be looked upon as true adenomata. The density and hardness of an enlarged prostate depend upon whether the gland tissue or the stroma is more abundant. When it is due to excess of gland tissue, the organ feels much more elastic than when it is due to the excess of the stroma. In some prostates all parts of the organ are found equally affected, and when this is the case it seems to be uniformly enlarged. It is this condition which appears like hypertrophy. Sometimes only one lobe, and sometimes both lateral lobes, are affected.

In other prostates, whether greatly or slightly enlarged, there is not the appearance of hypertrophy, but rather that of tumour formation. On section of such organs there is great difference to the naked eye. Instead of the section being of even consistence, as is the case in those which have just been mentioned, it has an uneven surface, bulging slightly in parts. This is due to the alteration in structure not being equally advanced throughout the organ. Those parts which are affected appear as isolated tumours. There may be one tumour only, or there may be many. One lobe only may contain a tumour, or all the lobes may contain them. In prostates which contain many tumours the growths are not always of equal size, some being much larger than others and varying from the size of small shot to that of hens' eggs. A common form of enlarged prostate is that in which the tumours are of fairly uniform size, and closely packed together. In such specimens the suggestion is strong that each tumour is an enlarged lobule of the prostate. Those lobules which become en-

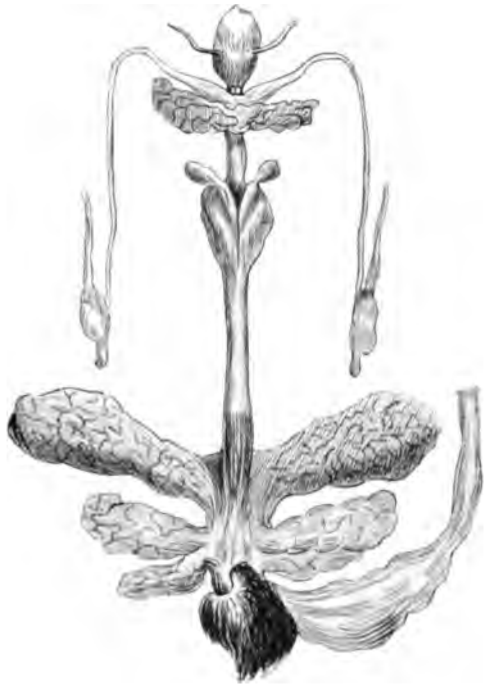

Fig. 31.

Genitalia of Beaver (Owen).

larged press upon the adjacent lobules, which become altered in form by compression and so much flattened that they appear to the naked eye like capsules to the growths. If the lobule be at the surface of the prostate, as it enlarges it bulges the true capsule of the organ, and the outer surface of the prostate thus becomes nodular. This bulging may go so far as to form a separate tumour in the same manner as a sub-peritoneal myoma of the uterus; it is rare, however, to find very marked bulging on the exterior surface. As the growths enlarge they expand the capsule of the prostate, but they project mostly towards the bladder and urethra—that is to say, they naturally expand in the direction of least resistance. It is this which causes the enlargement of the prostate to obstruct the outflow of urine from the bladder. If there were no impediment to micturition, the enlargement of the prostate would never cause symptoms. It is an innocent affection, so far as the prostate itself is concerned, and may be considered the normal, although often extravagant, method of degeneration. It is not a disease until, by the accident of its position, it obstructs the outlet of the bladder. The obstruction is caused in various ways, depending upon the position of the tumours with regard to the urethra. The urethra is always increased in length, and, as the prostate cannot descend on account of the fixity of the triangular ligament, it follows that the lengthening must take place in an upward direction towards the bladder, the outlet of which is usually found to be raised. The urethra is also increased in antero-posterior diameter commensurate with the amount of enlargement of the lateral lobes. It is sometimes triradiate in transverse section, and this occurs chiefly when the part behind the urethra is enlarged as well as the lateral lobes. In some cases it is triradiate in its upper part, due to enlargement of lateral and middle lobes, and like a fissure in its lower part. In other cases it is nearly normal in all parts except at the actual outlet of the bladder, where its posterior surface is elongated by an enlarged middle lobe. The urethra is sometimes tortuous, as can be readily imagined must be the case when tumours of various sizes and in different positions lie under its mucous membrane. This deviation of the course of the urethra causes difficulty in the passage of instruments into the bladder, but there is one particular alteration in the course of the urethra which causes more difficulty than any other, and that occurs when there is an enlargement behind the upper part—an enlargement of the middle lobe. In such cases a catheter impinges against the projecting tumour, and cannot be passed into the bladder until the point of the catheter is projected forward. It will be seen that inasmuch as the urethra is always enlarged in circumference, although its walls may be pressed together, the largest catheter will be most easily passed. The expansion of the urethra is sometimes great, and a catheter may draw off so much urine from the expanded urethra as to give an impression that the bladder itself has been reached. Several ounces of urine may be contained in the urethra when it is much expanded by enlargement of the prostate. The commonest form of enlargement is that of the lateral lobes, but sometimes these are not markedly enlarged, while the middle lobe is a conspicuous tumour which projects into the bladder. The middle lobe is particularly apt to cause obstruction to the outflow of urine, on account of its position at the orifice of the urethra, where it may act like a ball valve. In other cases the middle lobe does not project so much into the bladder as into the urethra, which it pushes forward, and then not only forms an obstruction to the outflow from the bladder, but an impediment to the introduction of a catheter. Another form of isolated prostatic tumour is very occasionally found in a slight enlargement of the verumontanum.

Retention of urine, due to the enlargement of the prostate, is much the most urgent and distressing symptom of that complaint. Patients with enlarged prostates do not necessarily suffer from it, very many escape it altogether, but a large proportion of them do, either temporarily or permanently, arrive at a stage when they are totally unable to pass any urine unaided. The causes of complete retention are two: in one class of cases it is due to impaction of an enlarged middle lobe in the outlet of the bladder, where it acts like a ball valve; in the other class it is due to swelling of the mucous membrane of the outlet of the bladder or of the prostatic urethra. The former comprises comparatively few, whereas the latter class contains the vast majority of cases of retention of urine. There is no doubt that many cases are due to valvular action of a pedunculated middle lobe, it being the only part of the prostate which shows any visible enlargement, and it is such cases which are typical of this form of retention. The patient has probably not had much trouble with his urine, beyond noticing a little increased frequency in the desire to micturate; the stream is full and well projected; he is not conscious of any undue straining when passing his water, which is clear. Suddenly and without warning he is unable to pass any water. The stoppage may begin at the commencement of the act of micturition, or during the act, or towards its termination.

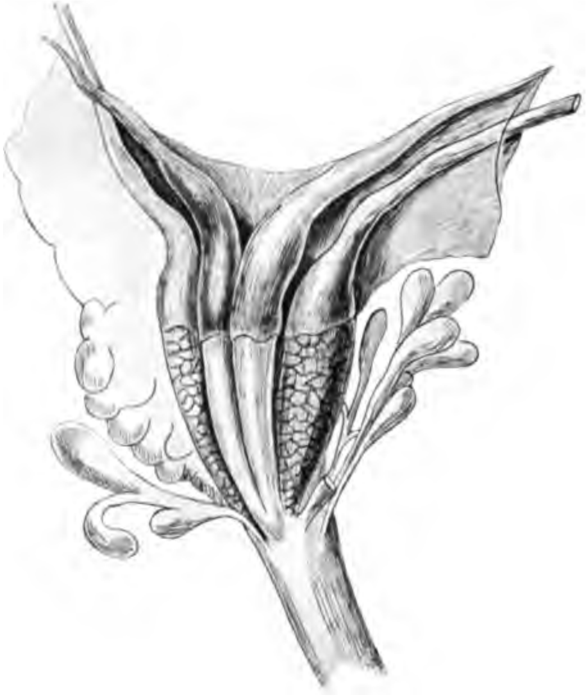

Fig. 32.

Double Utriculus Masculinus, and terminations of Seminal Vesicles, of Beaver (Owen).

Sometimes a short rest will relieve the obstruction. If it is not speedily relieved, the patient is quickly in most urgent distress, more urgent than any other patients with enlarged prostates. The bladder is comparatively healthy, and its muscular wall contracts forcibly in its effort to overcome the obstruction; similar contraction of involuntary muscle is seen in cases of obstruction of the ureter, cystic duct, or intestine; in all such cases the pain is extreme. As the bladder becomes more distended there is increasing difficulty for the urine to pass from the ureter into the bladder, because of the oblique passage of the ureter through the bladder-wall. The urine then collects in the ureters and quickly distends them, with the result that they, in their turn, contract forcibly, and give rise to pain passing down from the loins towards the front of the thighs. If relief is still not given, then the pain extends into the back, and the patient becomes in the most piteous condition. There is a limit, however, to the pain. The bladder muscle tires and becomes so much overstretched that it ceases to contract, and so the pain slackens. After this the bladder merely stretches, and there is a general tenderness and soreness over it, in place of the acute slowly rhythmic pain of the earlier stages of retention. The bladder may distend so as to hold many pints of urine. This is the least common form of retention of urine with enlarged prostate, and it is distinguished from other cases by the fact that it comes without warning, is easily relieved although it is so acute, and, being relieved, it may not recur; there may be no other symptoms of enlarged prostate, nor anything to be detected per rectum. Such an attack of retention of urine may occur in a patient who has enlargement of the lateral lobe as well as of the middle lobe, but in such cases there are other evidences of prostatic enlargement, and the symptoms and causes are blended with those arising from swelling and congestion of the mucous membrane.

In most cases of retention of urine the attack is preceded for long by symptoms of enlargement of the prostate. The patient has probably suffered from all the usual symptoms, such as frequent micturition, straining, and residual urine. As a result of fatigue, catching cold, an error in diet, alcoholic indulgence, or constipation, or perhaps on account of having been in circumstances where he has not had an opportunity to pass his urine and has thus allowed his bladder to become overfull, the tissues about the outlet of the bladder become congested and the mucous membrane becomes swollen in consequence. The patient strains to try to overcome the increased resistance thus presented to the outflow of urine, but the straining has the effect of making the congestion and swelling worse and the obstruction complete. The symptoms of such a condition are essentially the same as those which arise from the impaction of a movable middle lobe, but they are not so intense, because the bladder of a patient who has suffered for long from enlarged prostate, with difficulty of micturition, is already dilated to a greater or less degree; and its muscular wall has undergone change, so that it is incapable of vigorous contraction. The pain is therefore less acute, and the patient is not in such extreme distress. Whatever the size or position of the tumours in the prostate of those who arrive at the stage of actual retention, the final cause of the retention is congestion and swelling of the mucous membrane. If unrelieved, the urine continues to accumulate in the bladder, which may be distended to an enormous size. I have twice drawn off more than ninety ounces. Such distension is a very serious thing, not only on account of the damage which the bladder itself sustains, but also because the ureters and kidneys are affected by it. The overfull bladder ascends higher and higher from the pubes until it may reach the umbilicus, and between these points it is felt and seen as a rounded even tumour much like a pregnant uterus. It does not always assume this shape; sometimes it bulges to one side more than to the other; and I have seen one patient in whom the bladder was mistaken for a double tumour in the abdomen, because the area of dullness only extended halfway between the pubes and umbilicus in the middle line; but there was a large tumour in each iliac region, that on the left reaching to the iliac crest, and that on the right reaching as high as the lumbar region. Each swelling was hard and visible. A silver prostate instrument entered the bladder, and the tumour disappeared after about eighty ounces of urine had been withdrawn. A bladder which has been greatly distended is slow to recover its power. The effect on the kidneys arises from the resistance which is offered by the valve-like oblique direction of the lower end of the ureter as it passes through the bladder-wall. When the bladder is distended the walls of this part of the ureter are firmly compressed, and the more the pressure in the bladder the tighter the closure of the outlet of the ureter becomes. There is no actual passage of urine from the bladder back into the ureter. Such a thing has been known to occur from a bladder which was not overfull, but it never occurs when there is distension. When the pressure arrives at a certain point, more force is required to

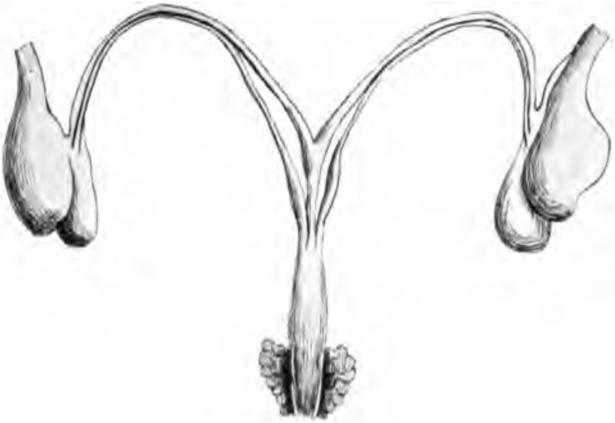

Fig. 33.

Genitalia of Goat, showing Utriculus Masculinus continued by Cornua as far as Epididymis and widely separated from the Prostates (Owen).

expel the urine from the ureter into the bladder, and the force required increases with every drop which is thus driven into the bladder. Before long the pressure becomes so great that the ureter itself cannot exert enough force to expel its contents, and the urine collects in it and causes it to dilate. Such dilatation begins at the lower end and gradually extends to the pelvis of the kidney. Post-mortem, it is not uncommon to find dilated pelves of the kidneys and also dilatation of the entire ureters, but when one half of a ureter is dilated it is always the lower half. The ureter passes through the same phases as the bladder, and may become permanently expanded. The same occurs in the pelvis of the kidney. The most serious effect of prolonged obstruction or retention is seen in the kidneys, which also become expanded and their secreting structures permanently damaged.

Treatment of Retention of Urine.—This naturally aims at emptying the bladder with as little delay as possible, and the first and simplest proceeding is to pass a catheter per urethram. The obstruction is mechanical, and is not relieved by hot baths and the various methods which are employed successfully in retention due to stricture. The patient must be placed in a warm bed with hot bottles and well covered with blankets; the shoulders should be raised so as to relax the abdominal muscles and thus take off as much pressure on the bladder as possible. The necessary catheters of various kinds should be ready in warm lotion. The patient is uncovered carefully, so that he may not be cold during the operation. The end of the penis is washed well with 1-1000 corrosive sublimate lotion, so as to remove as far as possible any microbes which are present. A soft india-rubber catheter is then taken, not less than No. 8 English scale, and the end is dipped in castor oil before it is inserted into the meatus. The catheter is then passed gently but as continuously as possible into the bladder. Just before it enters the bladder it generally causes some increase of the desire to micturate, and this may be taken as an indication that it has reached the upper part of the prostatic urethra. When the eye of the catheter enters the prostatic urethra, a little urine may pass for a few moments and then the flow stops; this is only what has been lying in the urethra. When the catheter enters the bladder there is an immediate full stream of urine, which may be projected a long way; this energy of the stream soon diminishes, as it is due to the pressure of the abdominal walls rather than the wall of the bladder. As the quantity of urine drawn off increases, the flow becomes less and less. until, if the distension has been extreme, it only flows during inspiration and ceases during expiration. Shortly it ceases altogether, but if the hand be pressed into the pelvis a considerable quantity of urine will begin again to flow, thus showing that the muscle-wall of the bladder has become powerless to expel the last quantity. It is not advisable to completely empty an over-distended bladder, because the sudden relief of pressure on the walls is followed by congestion of the mucous membrane and, possibly, by hæmorrhage. The fact that a soft rubber catheter has passed easily makes it probable that the same proceeding will be equally easy if it requires to be repeated.

It often happens that an india-rubber catheter cannot be passed into the bladder. Under such circumstances some other form of catheter must be tried. The cause of the failure is found, as a rule, in some deviation of the urethra due to pressure, either at the side, or behind, or occasionally in front of the urethra, by a tumour or tumours in addition to swelling of the mucous membrane. The catheters which may be used are made of various materials and have different designs. There are soft flexible instruments made of cotton or silk, and rigid metal instruments. Of the flexible catheters there are the cotton gum-elastic, which has a thick wire stilette down the barrel; the straight blunt-ended silk; the straight bulbous-ended silk; the coudée, which has the terminal half-inch sharply turned up; and the bicoudée, which has a second elbow about an inch from the tip. Of the metal rigid catheters there are two patterns—the ordinary and the prostatic. Each of these instruments will on occasion pass when the others fail. If the india-rubber catheter fails to enter the bladder, it may be that the failure is simply due to the swollen condition of the mucous membrane, in which case the next instrument to be tried is a catheter of the same shape and size but slightly more rigid—such an instrument is found in the straight blunt-ended silk catheter. If this fails, a straight silk catheter with a conical point is tried. If it fails, a similar catheter with a bulbous end may succeed; but if this also fails, a coudée or a bicoudée may be tried. It is very rare to find all these catheters fail. If the obstruction is due to the swollen condition of the mucous membrane alone, one of the straight instruments will usually succeed, particularly the bulbous-ended catheter. If the difficulty is due mostly to deflection of the urethra, the coudée or bicoudée will pass the obstruction. But if all of these instruments should have been tried and have failed to enter the bladder, then a still more rigid and differently shaped catheter must be used. The choice may fall on one of three—

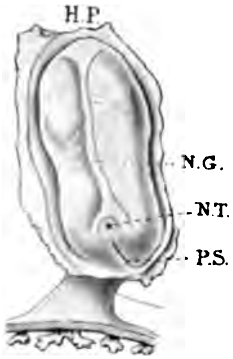

Fig. 34.

Dorsal View of 2 mm. Human Embryo, $\frac{14}{1}$; P.S., Primitive streak; N.T., Neurenteric canal entering yolk-sac; N.G., Neural groove; H.P., Head end of embryo (Graf Spee). (After Dr. D. Berry Hart; 'Journal of Anatomy and Physiology,' April, 1901.)

the gum-elastic, the ordinary silver, or the prostatic catheter. The gum-elastic catheter is used in one of two ways, each having the same object, namely to keep the beak of the catheter in close contact with the anterior wall of the urethra, so that when it reaches the obstructing projection of the lateral or posterior walls it may glide along the anterior wall and so avoid the difficulty. Tumours of the anterior wall are so rare that they may be almost neglected as causes of retention of urine. One method of using the gum-elastic catheter is as follows: withdraw the stilette and with the fingers curve it so that the sweep of the curve is more than a third of a circle, then insert it into the catheter, which will itself take the same curve as the stilette. If the catheter be now passed as far as those which have previously been used, and it meets the same obstruction, then slowly withdraw the stilette while the catheter is at the same time gently pressed towards the bladder; the withdrawal of the stilette tilts the beak of the catheter very much forward, and by this means it will often succeed in entering the bladder when other catheters have failed. Another method is to take a gum-elastic catheter without a stilette and to soak it in very hot lotion until it is soft and flexible; then wind it round the finger in concentric circles, and, while holding it in this form, plunge it into very cold lotion, in which it will set and remain in the wound-up form. It is now passed into the urethra, and as it passes the beak keeps actively against the roof of the urethra, and will often enter the bladder without any appreciable contact with the obstructing tumour. Should both these methods fail, recourse must be had to a metal prostatic catheter, which must be held with its beak close against the anterior wall of the urethra as it approaches the bladder. This will probably succeed, but if it should not the index finger may be passed into the rectum until it feels the back of the prostate; by pressing the prostate upwards higher into the pelvis, an obstructing tumour behind the urethra, particularly an obstructing middle lobe, may be so far raised as to allow the catheter to pass it. This latter manœuvre may be employed with any of the other catheters. Having succeeded with one of these catheters in entering the bladder and relieving the obstruction, the question arises whether the instrument should be removed. If it is removed it is probable that the same operation will have to be repeated in a few hours' time, with all its attendant shock to the patient, and irritation to the urethra. If it is allowed to remain, or is tied into the urethra, there is not so much acute suffering for the patient, but there is still the irritation of the swollen urethra, and a new danger is added in the likelihood of sepsis advancing up the catheter. If a catheter can be passed into the bladder without an inordinate amount of pain to the patient, and without causing too much bleeding (the sensitive and congested mucous membrane about the prostatic opening of the bladder is particularly liable to bleed during an attack of retention), it should not be left in the urethra, but should be used again and again so long as the inability to pass water lasts. The patient should be kept in bed, with warm clothing about him. The bowels should be thoroughly evacuated with a saline purgative. The diet should be light, and he should be given barley water to drink. By such treatment the congestion of the mucous membrane of the urethra will subside, and in a few days the patient will be able to pass his water as freely as he could before the attack. If the obstruction is due to a pedunculated middle lobe, he may be able to micturate voluntarily at the next call; but as a rule, although some urine may pass voluntarily, it will be found that the amount of residual urine has increased. If there has been extreme difficulty in introducing the catheter, so that the surgeon fears to repeat the operation, or if from any cause it will be impossible to relieve the patient when next he requires it, the catheter may have to be tied in the urethra, but this should never be done unless it is absolutely necessary. When for any reason the catheter is left in, the patient should be informed that it is only a temporary measure, and that some other form of drain will have to be provided in the course of a few days—that is, a suprapubic or a perineal opening into the bladder will have to be made, through which the urine may pass without hindrance until the bladder shall have recovered its former tone. If all attempts to introduce catheters have failed, some other means must be resorted to at once. These are puncture with a trocar and cannula above the pubes, or per rectum; and suprapubic or perineal cystotomy. Puncture per rectum should on no account be performed. It is a plunge in the dark, in a situation where the greatest amount of harm may be done, both by injury with the trocar at the time of the operation and by sepsis subsequently. Puncture above the pubes is anatomically safe, causes comparatively little pain, may be performed aseptically, and gives instant relief, but should only be employed when there is no cystitis, because there is sure to be some leakage of septic urine by the sides of the cannula into the loose tissue behind the pubes. The cannula is firmly gripped by the aponeurosis of the linea alba through which it has been thrust, and it is easier for the septic urine to spread in the retropubic fat than for it to gain the

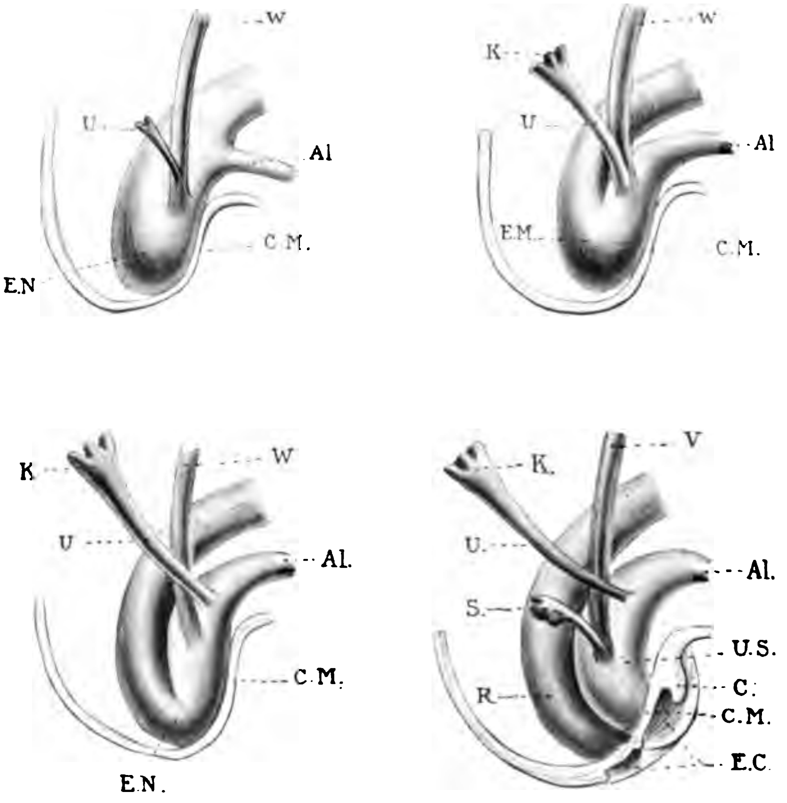

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FIG. 36.

Diagram to illustrate manner in which the Ureter, Vas Deferens, and the Bladder arise in the Embryo. C.M., Cloacal membrane; E.C., Ectodermal cloaca; E.N., Entodermal cloaca; Al., Allantois; U., Ureter; W., Wolffian duct; S., Seminal vesicle; B., Bladder; U.S., Urogenital sinus; C. Clitoris or penis; K., Pelvis of kidney; V., Vas deferens; R., Rectum.

surface. Therefore, if all attempts to pass catheters have failed and it is known that cystitis is present, cystotomy, either suprapubic or perineal, should be performed without delay. Suprapubic cystotomy has the advantage over the perineal operation, in that it can be performed with less disturbance of the patient, and can subsequently be kept cleaner. It is urged in favour of the perineal route that the opening in the bladder is in a more dependent position; this, however, is not an advantage which is found to exist in practice. If a bladder is drained both above the pubes and through the perineum nearly all the urine escapes by the upper tube; and if both tubes be removed, the perineal wound heals first. If it is probable that a permanent drain will be required, then the perineal operation may be preferred. Whatever operation is done, it must be looked upon as a temporary means of resting the bladder until it shall have recovered from the over-distension and cystitis: the primary object having been to relieve retention of urine.

Complications.—1. *Cystitis*, as a complication of enlargement of the prostate, is the most serious of all. It varies much in severity, being virulent and running a short course to a fatal termination in some cases, whereas in others it is mild and the patient recovers from many recurrent attacks. It is always caused by the introduction of septic organisms, and these are almost invariably introduced by catheters or other instruments used in the diagnosis or treatment. Organisms cannot effect a lodging in a healthy bladder in which there is no impediment to the outflow of urine. Such a bladder empties itself completely at each act of micturition, and the organisms are evacuated with the urine; any which escape evacuation are floated in the newly collected urine as it accumulates from the ureters, and are passed during the next act of micturition before they have had time to multiply. The bladder of a patient who requires to have a catheter passed to relieve symptoms due to an enlarged prostate, however, is in a very different condition. It never completely empties itself, so there is always a little residual urine; and any organisms which may have been introduced are placed under the most favourable conditions for their growth. Urine is a suitable fluid in which they can multiply; it is kept at an even temperature most favourable for them. Not only so, but the bladder-wall has been prepared, as it were, for their reception. The mucous membrane is congested in all cases of obstructed outflow from the bladder, and the straining during micturition increases the congestion; as a result the epithelium is less perfectly developed than in a normal bladder; the superficial cells are more easily shed and the underlying cells are exposed, so that the mucous membrane is not such a thoroughly non-absorbent surface as it should be. Coincident with this the bladder-wall becomes hypertrophied, and the overgrown muscular fasciculi form prominent interlacing bands like a coarse net below the mucous membrane. In the depressions between the muscle strands the mucous membrane dips and forms pockets, which often expand beneath the peritoneum and fascia of the bladder so as to form saccules. In all of these saccules the urine lodges, and, when they are deep and have a narrow communication with the bladder, the urine is not evacuated from them during micturition, and any germs which may have entered grow under the best of conditions. Under such circumstances the mucous membrane is acutely inflamed and of a deep red colour; it becomes œdematous and thick, and will bleed with the lightest touch; the epithelium becomes detached and minute hæmorrhages occur. The engorgement is made evident when a catheter is passed; the urine which first issues may be without any appearance of blood, but with the relief of support minute vessels give way, and the latter part of the urine drawn off is blood-tinged. The hyperæmia extends to the muscle-wall, which becomes swollen and œdematous also, and the muscle cannot contract so well as before, nor can the bladder expand without pain; consequently there is constant desire to micturate, and less and less ability to do so, and at the same time the patient complains of burning pain about the pubes. The process may stop at this stage or it may advance, in which latter case it may go on to gangrene of patches of the mucous membrane, or even of the whole bladder-wall. The urine from such a case is excessively foul, ammoniacal, blood-stained, perhaps deeply, and full of pus and septic organisms. The patient shows the symptoms of septic absorption, looks ill, with fast pulse and dry tongue, but the temperature may not be much affected. The process spreads to the ureters and to the pelves of the kidneys, all of which show the evidences of acute septic inflammation. It spreads into the substance of the kidneys, and multiple small abscesses form in them. The patient passes into a uræmic condition and dies. Cystitis is not always, or even usually, so acute or destructive. The process generally advances more slowly and may be relieved by treatment, but it is essentially the same.[1] The bladder from a case of chronic cystitis has the

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[1] In most cases the acute attack subsides, never having been so violent as that just described. It generally passes into a condition of chronic cystitis.

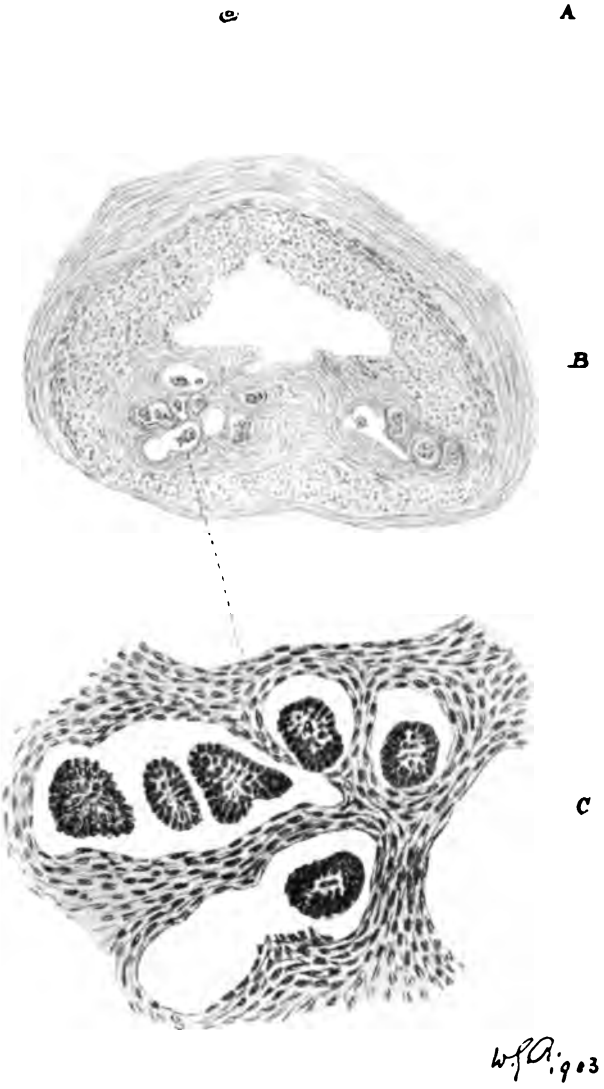

FIG. 37.

Transverse Section of Fœtal Prostate at 3½ months. A, natural size; B, magnified; C, Portion of B more highly magnified (from micro-specimen 66).

following features: The mucous membrane is thick and of a very deep red colour. Its surface has lost its polish and looks rough, due to the loss of epithelial covering. The connective tissue is infiltrated with small cells, and many of the veins are filled with thrombi. Small-cell infiltration has taken place among the muscle fibres, the apparently strong bars of muscle being mostly composed of new tissue, the result of inflammation. The symptoms of chronic cystitis are those, exaggerated, of enlargement of the prostate with the addition of changes in the character of the urine. A patient who has been using a catheter for perhaps a long time finds his symptoms much aggravated. The passage of the catheter is more painful, and it has to be resorted to much more frequently; soon the catheterism fails to give relief and may cause some bleeding, with acute pain on account of abrasion of the mucous membrane. The urine, which before was clear and looked normal, is now muddy and has a disagreeable odour; the first part which passes is thin and runs through the catheter, but the last portion is thick and contains a white sediment, and when this portion makes its appearance there is acute pain and perhaps a little blood. The patient's condition is one of the utmost misery. He devotes all his time to attending to urination; perhaps having to pass the catheter every ten or fifteen minutes. The bladder has almost wholly lost its power of contraction, and even if he can pass a little urine without the use of the catheter, he finds that the bladder is not empty and so passes the instrument. The passage of the catheter is painful, but the desire to micturate is keener. He obtains no sleep; he has no appetite. Straining causes congestion of the pelvic structures, and he finds that the effort to micturate is followed by the passage of mucus per anum, and hæmorrhoids may make his misery complete. Under treatment the symptoms abate, and the patient's condition becomes bearable, but he does not return. to the state of health in which he was before the attack. The bladder has received permanent damage, its walls are more rigid, and although they may appear to be immensely hypertrophied, the thickening is due to fibroid changes consequent upon the inflammation and not to increase in the muscle fibres; on the contrary, the muscle is diminished. Another consequence of the change in the bladder-wall is that it becomes less distensible, and when urine collects beyond a certain amount the call to micturate becomes very urgent. If such attacks as this recur often, the patient's health suffers, because each attack is accompanied by further injury to the kidneys. He may pass more urine in the course of twenty-four hours, but it shows a steady fall in specific gravity and in the percentage of urea. He becomes pale and much older in appearance, and it is obvious to his friends that he is ill.

2. *Thrombosis of the prostatic sinuses* usually occurs in conjunction with cystitis, with which its symptoms are blended. When thrombosis occurs there is more pain in the perineum and down the back of the thighs. Rectal examination is excessively painful, and the patient cannot sit down because of the pressure on the perineum when he does so. He does not strain to pass his water, because this also causes pressure, and defæcation is also painful.

3. *Abscess* about the prostate gland arises from thrombosis of the prostatic sinuses. It is dealt with in connection with abscess arising from other causes.

4. *Orchitis* is a common complication of enlargement of the prostate, and it always arises as a consequence of sepsis introduced by catheters. The testicle becomes swollen, painful, and tender, and it feels heavy. The skin of the scrotum becomes red, and the pain is much aggravated if the testicle is allowed to hang down. The patient becomes feverish and feels ill. The inflammation may subside, to be followed by recurrence of similar attacks at intervals of a few weeks or even of years; or it may go on to the formation of an abscess of the testicle, with discharge of pus spontaneously or in consequence of an incision by a surgeon. Such abscesses heal well, but they may be followed by atrophy of the testicle. The beneficial effect of such atrophy is alluded to in connection with orchidectomy as a method of treatment of enlargement of the prostate.

Treatment of Complications.—1. *Cystitis.* Acute cystitis is in every way a most difficult ailment to treat with any hope of benefit. The subjects of it are usually in ill health before the attack. It spreads rapidly to the kidneys and so affects a vital organ. The bladder is fasciculated if not sacculated, and therefore a singularly difficult cavity to which local treatment can be applied, and such local treatment fails to penetrate as far into the tissues as the septic process has advanced. The patient must be kept warm in bed and encouraged to perspire. The bowels must be freely purged. Stimulants must be given. He must have fluid diet and diluent drinks, and hot linseed poultices should be applied to the loins and flanks. Inasmuch as the attack is brought on by catheters which have been used to relieve obstruction to the outflow of urine, the obstruction remains, and

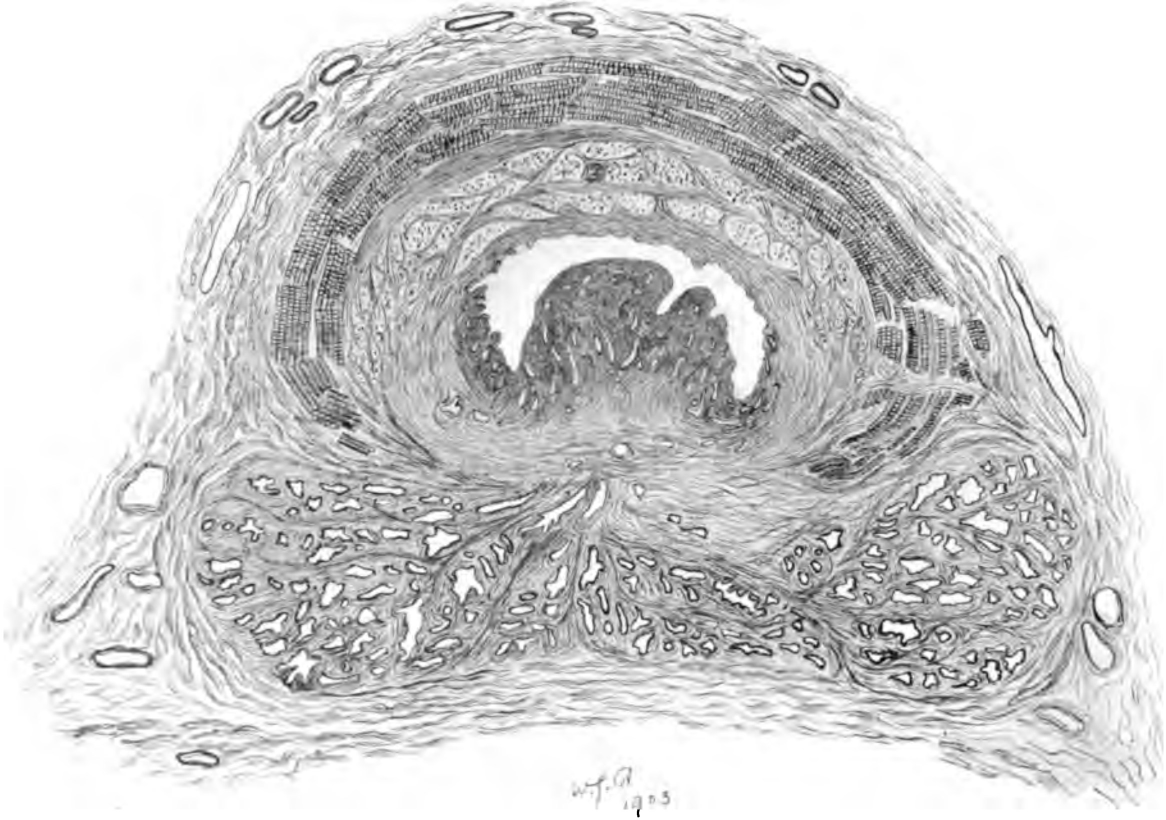

Fig. 38.
Transverse Section of Prostate of Full-term Human Fœtus (from specimen 67).

catheters can only aggravate the already acutely inflamed neck of the bladder; they must therefore be discarded, and an artificial opening must be made into the bladder. The cleanest and most accessible position for such an opening is above the pubes; suprapubic cystotomy should therefore be done without delay; and a large rubber tube should be inserted into the bladder; through this tube the bladder can be washed out every few hours with hot boric acid lotion; and in the interval any urine will flow through the tube as freely as it would if the opening had been made in the perineum. The prognosis in all such cases is exceedingly grave, and it depends chiefly upon the vigour of the patient.

The treatment of chronic cystitis is the same as that of the acute affection, but there is not the same urgency. The patient will sometimes refuse to be confined to bed. Such patients often continue to go about until weariness and pain prevent them. In such cases the treatment is chiefly local. The general treatment is the same as in acute cystitis, and it is more successful because there is not the same amount of fever and septic absorption. The local treatment is also essentially the same, but there is a larger choice of measures. It may be possible to wash the bladder through a catheter if the patient refuses an operation; or it may seem probable that the artificial opening will have to be permanent, in which case the patient may choose a perineal rather than a suprapubic operation. Whatever is decided on, it must have this feature, that the bladder will drain and be irrigated through the inserted tube. The treatment of thrombosis of the prostatic sinuses, if a complication of acute cystitis, is that of the graver and overshadowing affection. Some relief is given by hot applications to the perineum. An abscess of the testicle should be opened freely, and the patient should remain in bed until it is healed. Hot fomentations of boric acid are clean and comfortable applications, and much relief is given by a pad under the scrotum so as to raise it to the level of the pubes.

Treatment of Chronic Enlargement of the Prostate.—To be precise, there is only one form of treatment of this complaint, and that is by operation upon the prostate itself; either with a view to diminishing the obstruction, or by removal of the obstruction altogether. All other treatment, whether medicinal or with catheters, is directed to the relief of the consequences of an enlarged prostate, and not to the cure of the affection itself.

If no treatment whatever were adopted in a series of cases, the malady would follow one of the following courses: In those cases in which the growth caused sudden and unforeseen retention of urine, the patient would pass through the ordeal without, as might be expected, rupture of the bladder. After the bladder had become distended to such a degree that active muscular contraction was no longer possible, it would continue to stretch, and the retention of urine would be succeeded by incontinence. Incontinence would only relieve the bladder to the extent of getting rid of such urine as accumulated over and above that which had distended the bladder. Coincident with this the ureters and pelves of the kidneys would be dilated, and the kidneys themselves would feel the effect of the pressure. Before long the kidneys would give evidence of the damage which they sustained in the character of the urine which they excreted. It would increase in quantity, the specific gravity would gradually fall, and the amount of urea would decrease. The patient would suffer in health on account of the failure of the kidneys to perform their function, and he would either become uræmic or succumb to some trifling disease which he could have withstood in former years. He would not, however, suffer from cystitis. In those cases in which enlargement of the prostate was known to exist, and in which an attack of retention might have been expected, the patient would, in consequence of catching cold, or of having taken alcohol or an unsuitable dinner, or through one of the various causes which bring about congestion of the pelvic viscera, suffer from absolute retention. Unlike the previous supposed case, he would have an already distended bladder, and probably some disorganisation of the kidneys. He would pass through the same course, however, only he would start from a point a little farther from normal; yet he would not suffer from cystitis. In a third class of cases, the prostate not being enlarged in a form which could cause absolute retention of urine, the patient would pass through the same course, but at a greatly reduced speed. The bladder would dilate and contain residual urine, which would steadily increase in amount, and the kidneys would slowly become injured, and the patient's life would terminate earlier than if he had not suffered from enlargement of the prostate; yet he would not suffer from cystitis. Whatever the form of enlargement, if it causes any obstruction to the outflow of urine from the bladder, the injury sustained by the patient is the same. Such injury may be very slow in developing, but it is always of the same nature, namely distension of the bladder and secondary dilatation of the ureters, with damage to the kidneys and

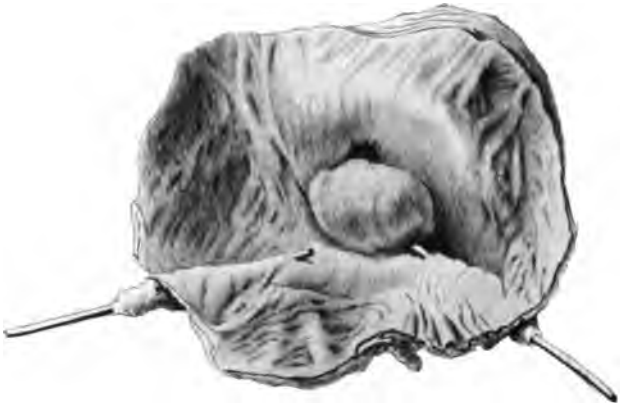

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Fig. 39.

Common form of Enlarged Middle Lobe of Prostate (from specimen 29).

impairment of health. All treatment aims at one of two things: either to prevent distension of the bladder by artificially withdrawing the urine, or to remove the cause altogether. The other details of treatment arise from the necessity to relieve symptoms which are due to cystitis, and this is always caused by the passage of instruments.

The means employed to prevent distension of the bladder and collection of residual urine with all their evil consequences, are two: the use of catheters, or the formation of an artificial opening through which the urine drains. To remove the cause of the distension there are several methods: the prostatic urethra and outlet of the bladder may be kept patent by the occasional passage of a large-sized instrument; or an obstructing collar-like ring at the outlet of the bladder may be divided by the knife or the cautery; or the growths within the prostate may be removed through a suprapubic or a perineal incision; or the prostate itself may be made to atrophy by removal of the testes.

The Employment of Catheters.—This is the commonest form of treatment, and there cannot be any doubt that it is entirely successful in many cases; at the same time it must be owned that it is the cause of much pain and suffering, and even of the death of many patients. Cystitis is always due to the introduction of sepsis into the bladder on an instrument, and few men make use of a catheter for long without having an attack of cystitis. It is perfectly true that a patient can obtain, in a convenient form, the instruments necessary for the perfect sterilisation of his catheter; and he can be taught and can practise the art of carrying out the operation aseptically with success; but very few men have the leisure or opportunity to give the process sufficient attention. The great bulk of our patients must of necessity be men who have their business to attend to; most of them are engaged in manual work, and it is quite impossible for them to pass a clean catheter whenever it is required. There are many men who have made use of catheters for years and who have never had any cystitis, in spite of the fact that the instrument is merely carried in the hat or a pocket, and no attempt is made to clean it. Others who act in the same way do not escape attacks of cystitis, but they surmount them and their health does not visibly suffer. Such cases as these are surgical curiosities, and they do not weaken the charge against catheters, that they are the one great cause of cystitis and of the death of large numbers of patients. The indication for the use of a catheter is the amount of residual urine. If there are only two or three ounces, the catheter should be passed just before the patient gets into bed. He will be much relieved by it, and will not be disturbed so often during the night. If the residual urine amounts to four or five ounces, the catheter should be passed night and morning. If there are six or seven ounces, it must be passed every eight hours. If eight to ten ounces, then every six hours. The object of the catheterism is to reduce the amount of residual urine, and its employment is indicated whenever residual urine is found, no matter what the form of enlargement of the prostate may be. A catheter is not only employed to relieve absolute retention; its chief use is to prevent the ill effects of milder degrees of obstruction to the outflow of urine. The form of catheter depends upon the nature of the obstruction. Whenever possible, an india-rubber catheter should be used. The softer the instrument the less pain is caused, and the less irritation of the mucous membrane about the neck of the bladder; for it must always be borne in mind that the mucous membrane in such cases is much congested. Neither a small nor a very large size of catheter should be used. Numbers 8, 9, or 10 are the most suitable. The most important detail in the treatment is attention to cleanliness. The patient's hands, the catheter, and the end of the penis must be carefully sterilised each time that the catheter is used. The catheter may be cleaned either by scalding it or by immersing it for a time in antiseptic lotion. Mere dipping of the catheter in lotion and then in carbolic oil gives no guarantee against sepsis. It must be scalded immediately after use, then dried and carefully set aside in a clean receptacle; and it must be scalded again immediately before use. A couple of minutes in boiling water is a sufficiently long time to make a clean catheter sterile. If the catheter is kept in an antiseptic lotion it must be washed in boiling water before being used, so that the lotion may be removed, otherwise it will irritate the urethra. The patient must wash his hands and scrub the fingers with antiseptic lotion. The prepuce must be drawn back, and the whole glans penis must be washed with lotion also. It is not necessary to attempt to sterilise the urethra, as any instrument which is passed along it, with the view of washing out the urethra, must of necessity carry any organisms with it in the same manner as the catheter. The patient's hands, the catheter, and the end of the penis having been cleansed, the catheter is passed as gently as possible, and as soon as urine flows freely it indicates that the eye of the catheter has entered the bladder, and it should not be pressed farther in. It is manifest that preparations and care

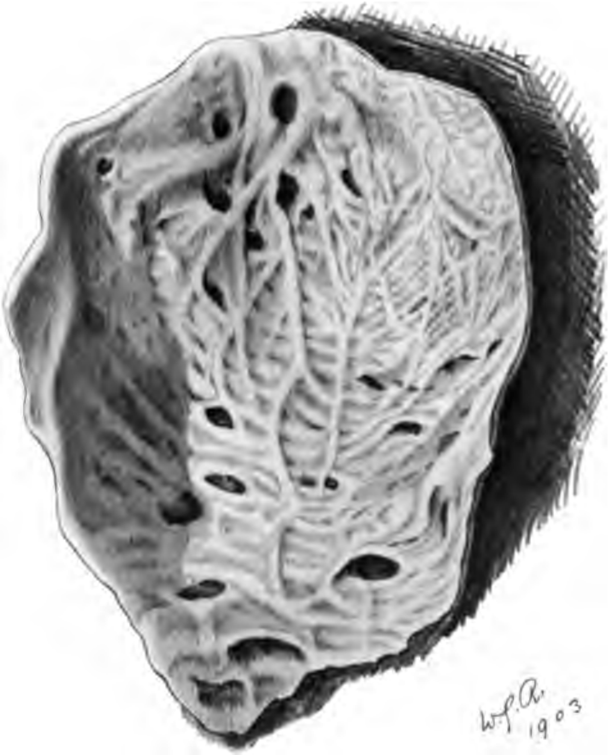

Fig. 40

Sacculated Bladder-wall (from specimen 30).

such as these are quite impossible for a working man to carry out. To be safe while employing a catheter, a patient must have time and opportunities at his disposal, and if he has neither of these, he enters upon catheter life at great risk. If he cannot live without the use of the catheter, he is sure to get cystitis; and if he can exist without it, he is equally sure to discard its use and wait until he is compelled to resort to it again. The latter course is the one which nearly all patients follow, and they only return to the surgeon when they are suffering from absolute retention, or when their health is broken down by loss of sleep and renal disease.

If from any cause it is not possible to carry out treatment by means of a catheter, the patient may be saved from the effects of residual urine by having an artificial opening made in the bladder. Through this the urine drains away as soon as it enters the bladder. The opening may be made in the perineum or above the pubes. Through it a tube is passed which keeps the opening free, and the urine is collected in a receptacle which the patient has to wear constantly. It is not only a disagreeable condition of things, but it is not free from risk. Septic organisms are very apt to find their way along the sides of the opening and to set up cystitis. The bladder becomes inflamed, and a deposit of phosphatic matter takes place on the mucous membrane. The source of the contamination is seen in the way the deposit collects chiefly around the opening in the bladder. From this deposit particles fall free and become the nuclei of calculi, sometimes of large size. This is a means of treatment which is only applicable to men whose health is so broken down that a radical operation cannot be undertaken, and upon whom treatment by catheters is impossible.

To remove the cause of residual urine—that is to say, to make it possible for a patient to pass his water per urethram—and to completely empty his bladder an operation is necessary. The following methods of accomplishing this have been both advocated and practised; they may be divided into four classes:

1. Compression of the prostate and dilatation of the prostatic urethra.
2. Division of the obstruction.
3. Castration, or other means to bring about atrophy of the prostate.
4. Removal of the obstructing tumour.

The first of these proceedings is applicable to those cases in which there is general enlargement of the prostate, but no projection of isolated tumours into the urethra; cases in which, while there is difficulty in micturition and some congestion of the urethral mucous membrane, yet there is no retention of urine.

The second method is occasionally of use in cases where the obstruction is due to an enlargement of the posterior lip at the urethro-vesical junction.

The third method was devised with the hope that it would be a radical cure of all cases of enlarged prostate, and that by its employment the severer operations might be avoided.

The fourth method is applicable to all cases in which there is a definite tumour or tumours, if the health of the patient is such that an operation can be borne.

In applying the first method, a solid metal sound is used, of a size that will pass through the membranous portion of the urethra. The instrument is passed with the same precaution and care as are necessary in the passage of any catheter. It is allowed to remain in the urethra for ten minutes or a quarter of an hour. It should be employed very carefully once a week, and at bedtime, so that the patient may be kept warm during the operation and for some hours afterwards, as it is not free from the risk of causing rigors. Much good is often effected by this method of treatment. The channel of the urethra appears to be kept free by its use, congestion of the mucous membrane appears to be allayed, and when these results are brought about the patient is better able to empty his bladder. The accumulation of residual urine is thus prevented, and the ill effects of enlargement of the prostate are at any rate delayed. It does not stop the enlargement from proceeding, however, and is thus only a temporary means of treatment, but in some cases a useful means. In suitable cases it may give great relief for a time.

Division of an obstructing posterior lip, in cases where the enlargement is like an overgrown sphincter at the outlet of the bladder, has been advocated, and many cases of apparent cure have been recorded. In such cases the posterior edge is prominent, and it appears like a thick overhanging lip, which not only overlaps the beginning of the urethra, but greatly increases the length of its posterior surface. When this projecting lip is divided it no longer acts as an obstructing bar, as the urine can escape through the cleft. The division is made per urethram with either a knife or a cautery, and the edges of the cut are believed to contract as the cicatrix shrinks.

The third method of treatment is founded on the well-known physiological fact that castration of animals is followed

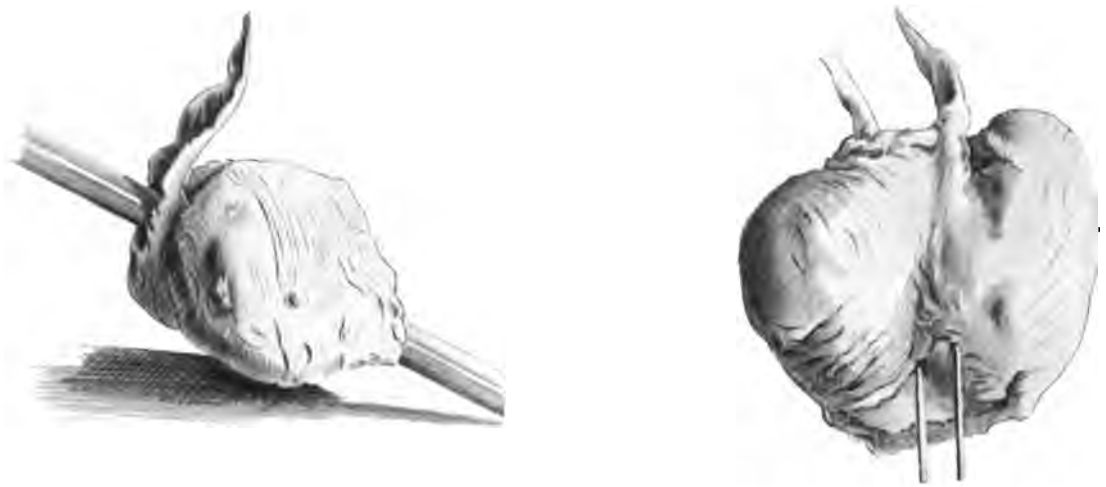

Fig. 41.

Prostate removed by suprapubic Prostatectomy (from specimen 45, case 1).

by atrophy of the prostate glands, and that in eunuchs the same thing occurs. Inferring also from the analogy—not homology—of uterine myomata and prostatic adenomata, and the fact that uterine myomata often shrank after the removal of the ovaries, it was hoped that prostatic tumours would shrink if the testes were removed. Accordingly the testes have been removed with the deliberate intention of causing atrophy of the enlarged prostate. The operation has been successful so far as its effect on the enlarged prostate is concerned, but it has been followed by an unexpectedly high mortality, and also occasionally by mental disturbance of the patient. Some patients refuse to have the operation performed on account of purely sentimental reasons. The improvement after the operation begins almost at once and is often satisfactory, but this mode of treatment has not been welcomed by surgeons or patients so warmly as might have been expected. It is nevertheless a fact that prostatic enlargement may be reduced by removal of the testes.

In order to avoid the disadvantages connected with removal of the testes, it was believed that if atrophy of the testicle could be induced by simple means, the same result, namely atrophy of the prostate, would follow. Accordingly the operations of division or excision of portions of the vasa deferentia were devised. Some successes have followed these operations, but they are not usually successful, and they have not been adopted as satisfactory means of effecting a cure. That atrophy of the prostate itself, and also of tumours in its substance, will follow atrophy of the testes, was illustrated by two patients. Each of these patients suffered for years from enlarged prostate. In one an attack of acute orchitis of the left testicle developed into an abscess, which was opened; it healed and was followed by atrophy of the testicle. Fifteen months afterwards I performed the operation of suprapubic prostatectomy upon him and enucleated a large adenoma from the right half of the prostate, but there was only a minute tumour, which was not enucleated, in the left half, corresponding to the side on which the testis was atrophied. Another patient, who had suffered for years from enlargement of the prostate and had been treated with catheters, had an attack of orchitis followed by an abscess in each testicle. A year after the second abscess was healed, he returned to his medical man to tell him that all his symptoms of enlarged prostate had gradually vanished, and that his micturition was normal.

Each of the foregoing methods of treatment may be employed with success, complete in some cases, and with benefit for a time in others; all, however, are uncertain. The aim of surgery has been directed, therefore, to discover some means by which patients may be rid once for all of the actual cause of their trouble.

Compression by means of a sound is a temporary measure. Catheterism is, in the vast majority of cases, an extremely dangerous mode of treatment; not less dangerous than it would be to allow patients with serious wounds to dress those wounds themselves. A certain number, no doubt, could carry out the dressing with antiseptic precautions, if they had leisure and opportunity to do so, but the majority of such wounds would become septic, and the mortality from septicæmia would be the same as in the old days of surgery. The analogy between cystitis and a septic wound is not merely fanciful; the explanation why patients are allowed to pass catheters on themselves as in the old days, and are not allowed to dress their wounds, can be found in the fact that, when a wound becomes septic, the relation of cause and effect is obvious, whereas the patient does not see that cystitis is due to a septic catheter. He cannot understand that the same instrument, which has been passed ninety-nine times without harm, has on the hundredth occasion produced cystitis. Therefore catheterism should be confined to those patients whom the surgeon knows to have the necessary intelligence, leisure, and opportunity to carry out the treatment safely; that is to say, it is applicable to a small proportion of cases.

Castration or vasectomy cannot be relied on, and should not therefore be performed until the patient has been told that they are no safer in their immediate result than, and not so likely to effect a radical cure as, removal of the prostatic tumour by other means. Division of a constricting collar or bar at the outlet of the bladder has the same defects. It is applicable to a limited number of cases, and even in them it does not ensure relief of a permanent character. If the above were the only means of treating chronic enlargement of the prostate, the outlook would be very discouraging; but in recent years many operations have been devised for the radical removal of the obstructing tumours; and the results have on the whole been much better than might have been expected. The mortality when compared with that which followed the first operations on the abdomen is surprisingly small. Against abdominal section the same objection was raised as is now urged against prostatectomy, namely that the death-rate following the operation was excessive. It can hardly be expected that the recoveries after prostatectomy will ever be

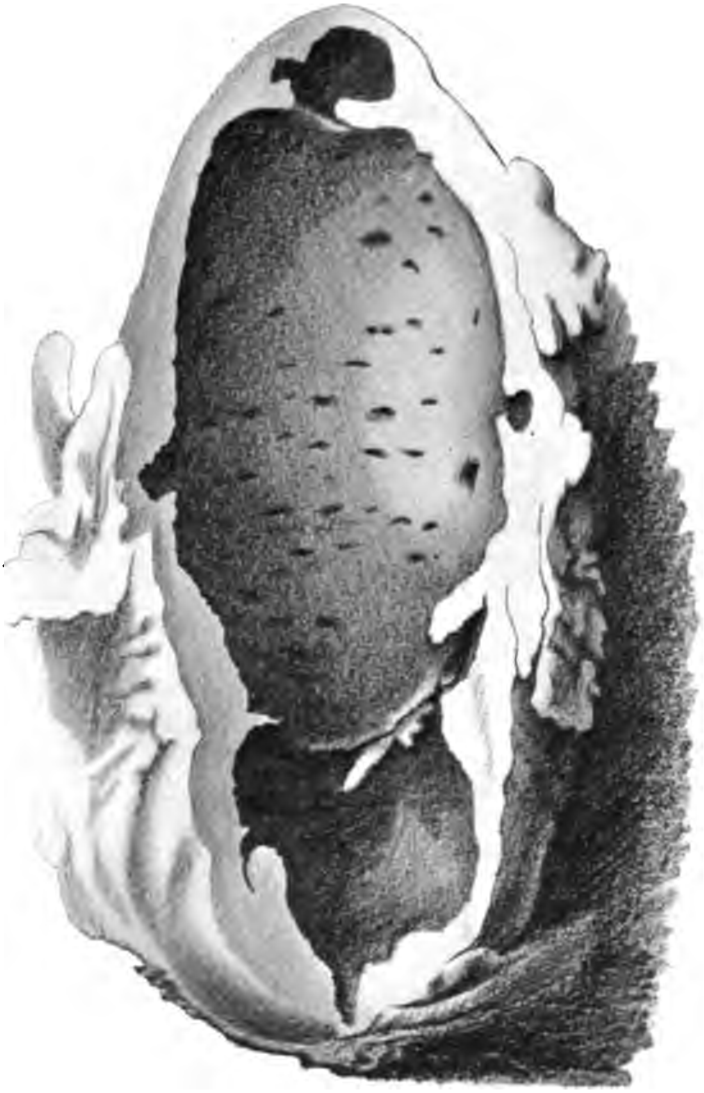

FIG. 42.

Bladder and Prostate after suprapubic Prostatectomy, showing the bed from which adenomata were removed (from specimen 35, case 30).

quite so large a percentage as those following abdominal section, because of the age of the patients who need it; but there can be no doubt that the mortality will be greatly reduced, not only because more perfect methods of removing prostatic tumours will be devised, but chiefly because patients will be operated upon at a much earlier age, and before they have become ruined in health by lack of sleep, cystitis, and renal disease. There are several methods of removal of prostatic tumours, and they all come into one of two classes, according to whether the prostate is approached from above the pubes or through the perineum. By the suprapubic route the middle lobe may be removed, and this may be done either by cutting it away with instruments introduced through the suprapubic wound, or by an écraseur passed per urethram. Large tumours of all lobes may be removed with the finger, and a thorough removal of the obstructing growths can be effected. The operation is a radical one, and it has the double advantage that the size and position of the tumours can be made out exactly, and the condition of the bladder can be investigated. Calculi can be readily removed at the same time, even if hidden in saccules.

Suprapubic Prostatectomy.—The patient is prepared in the manner usual for any abdominal operation. The day before the operation the pubic hair is shaved off, and the skin of the abdomen, penis, scrotum, and upper parts of thighs is washed and scrubbed with soft soap dissolved in methylated spirit; this is swilled off with hot water, and then the same area of skin is washed with turpentine, which is, in its turn, removed by another washing with spirit soap. After again removing the soap with water, the skin is douched with methylated spirit; after the spirit it is scrubbed with corrosive sublimate lotion (1–1000); and towels, which have been boiled and then soaked in the same lotion, are spread over the whole clean area, and a bandage is applied to keep the towels in place.

Fresh towels are applied early in the morning of the day fixed for the operation, and they are not disturbed until they are removed at the operation.

The patient is on his back on an ordinary operation table. It is well not to have a high table, because by it the difficulty of the operation may be considerably increased.

The anæsthetic must be very carefully administered. Chloroform is usually the best, because ether is specially apt to cause bronchitis. It is fortunately not necessary to induce deep anæsthesia, and thus the depressing effect of the chloroform is not great. Throughout the operation great care has to be taken, as it has always to be borne in mind that these patients are such that no surgeon would perform an operation of any kind upon them if he could avoid it.

The patient having been anæsthetised, a No. 8 or 9 soft rubber catheter is passed into the bladder and the urine is withdrawn. If a soft catheter cannot be passed, a more rigid instrument is used. After the bladder has been emptied, four ounces of boric acid lotion are injected through the catheter and then allowed to run out; this injection is repeated four or five times, and the last quantity is retained in the bladder by plugging the catheter. The heat of the boric lotion should be a little higher than the temperature of the patient. It is impossible to sterilise the interior of the bladder, therefore it is only necessary to continue the washing until the lotion returns nearly as clear as when it enters; four or five injections usually effect this; to continue the washing longer is to waste time, and that is very undesirable.

The towels are then removed, and an incision is made in the middle line immediately above the symphysis pubis; the incision varies in length with the size and stoutness of the patient, but its lower point is always fixed at the symphysis pubis, and any extension is made towards the umbilicus. In thin little men an incision two inches in length may suffice, but I had to make an incision about five inches long in one patient whose normal weight was twenty-two stones and who weighed eighteen stones ten pounds at the operation. Any increase in length of the incision only applies to the superficial structures—the skin and subcutaneous fat—as it is made to allow the hand to approach the external aponeurosis of the abdominal wall. Having exposed the aponeurosis, the incision is carried through it, then between the recti, and then through the fat which is found behind the recti, this part of the incision need not exceed two to two and a half inches in length, and should extend to the symphysis pubis, for by keeping as close to the symphysis as possible the shortest distance between the anterior surface of the aponeurosis and the prostate is gained. Immediately beneath the fat there is a very thin fascia which is apt to be mistaken for the peritoneum. Before continuing the incision through this fascia, the bladder is distended gradually by injecting more of the boric lotion through the catheter; no definite quantity is passed in, the injection being continued until the finger, which is passed to the bottom of the wound, feels the tense bladder rise towards it. The fascia

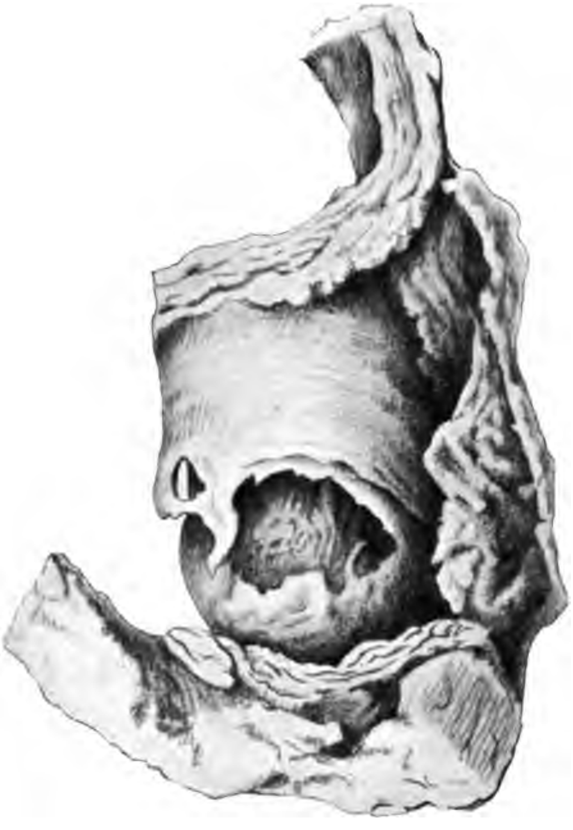

Fig. 43a.

Bladder and Prostate after suprapubic Prostatectomy, showing bed from which adenomata were removed, and a tear through the capsule into the sheath with

above mentioned is then incised, and is found to be the anterior boundary of the cleft in the retropubic fat which has been described in the account of the anatomy. The anterior surface of the bladder, covered by its own special fascia and fat, is then exposed. The index finger of the left hand is then passed to the bottom of the wound at its lower end, and the fat is gently pushed upwards, and, should the peritoneum dip down lower than usual, carries the peritoneum with it. It is seldom that the peritoneum is encountered in suprapubic prostatectomy. The anterior surface of the bladder is now seen and is recognised by the irregular bundles of muscle fibres, but chiefly by the veins, which in most patients who require this operation are engorged. The bladder-wall is then seized with two pairs of 'catch' forceps, about half an inch apart, in the lower half of the wound, and the knife is plunged into the bladder, the cutting edge being towards the pubes, and the incision is continued downwards a very short way, just so far as to make an opening large enough to admit the index finger, which is passed into the bladder at once, before the gush of lotion has ceased. The finger feels the catheter, and this leads it to the urethra, which can be fully explored as well as the base and walls of the bladder. It is then decided to what extent the enucleation should be carried. The operation so far has been performed while standing on the right of the patient. I am in the habit of now crossing to the left side of the patient, and enucleating the adenomata with the index finger of the right hand. The right index finger has advantages over that of the left hand; it is stronger, more dexterous, and its tip has undoubtedly a more delicate sense of touch—is a better eye. The right index finger is passed through the wound in the bladder, and the index and second finger of the left hand are passed into the rectum—the left arm being below the patient's left thigh, which has been raised slightly. By this means the prostate is pushed upwards and steadied, and the operation is greatly facilitated. The finger in the bladder then feels the catheter in the urethra; the catch forceps are removed from the bladder-wall, and the catheter is withdrawn from the penis. The tapered nozzle of a Higginson syringe is then placed in the meatus urinarius, and a continuous flow of hot boric lotion, 110° F., is injected through the penis into the bladder and out through the suprapubic wound, and it is kept up throughout the operation. If there is only an enlargement of the middle lobe, the operation merely consists in removing the projecting tumour with cutting forceps; but if it is necessary to enucleate larger masses, then the mucous membrane covering the tumours is scratched through with the finger-nail and the masses are turned out, first from one side of the urethra and then from the other. The larger the masses the easier the operation. In the case of a long-standing enlargement of the prostate the masses may be extremely difficult to enucleate, particularly if they are small, and in such a case it is well to enucleate the left half first, because when the finger is insinuated between the tumour and its 'surgical capsule,' on the left side, the nail of the finger is against the tumour and the pulp is against its capsule; the operation consists in separating the mass from its bed, and not the bed from the mass: that is to say, touch should be kept with the tumour rather than with its capsule; and it is certain that in a difficult case the sense of touch is less at the end of the operation than at the beginning. It is more difficult to separate the lowest part of the tumour than any other portion; and inasmuch as the finger-tip can be flexed under the right tumour but not under the left, it follows that the left side is more difficult than the right, and an advantage is gained by enucleating the left tumour before the finger is tired. Figs. 43 A and 43 B illustrate the greater difficulty in removing the left tumour; on the right side there is a perfectly clean bed from which a large adenoma was removed, but on the left side the finger had lost its way and got through the surgical capsule and among the veins in the sheath of the prostate—as a result of this the patient died of hæmorrhage.

When making the cut with the finger-nail through the mucous membrane, the incision should be kept as close to the urethral opening as possible; by doing so all danger of passing outside the capsule of the prostate, and performing total prostatectomy, is avoided. This unfortunate accident happened in the case of the patient from whom specimen 40 was removed. The sheath of the prostate was exposed, the prostatic veins were torn and there was very free hæmorrhage, which made it necessary to enlarge the opening in the front wall of the bladder, so that the bleeding points could be seen and caught. The operation was completed with scissors, the prostate being drawn upon by volsella. The patient recovered, but there followed, a few months afterwards, an incurable traumatic stricture, and he now wears a permanent perineal drain.

The adenomata having been removed from the bladder—if necessary with the aid of lithotomy forceps—a rubber tube is passed through the suprapubic wound down to the hollow from which the tumours have been removed. This tube should be thick-

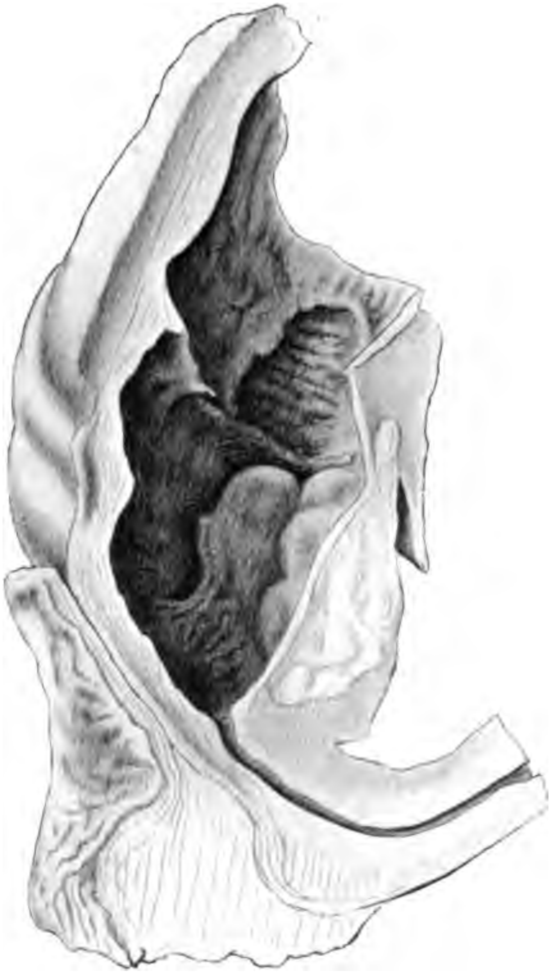

Fig. 43b.

consequent laceration of the veins, from which the patient died of hæmorrhage (from specimen 36, case 22).

walled and one third of an inch in inside diameter, and should project two inches beyond the skin wound. Two or three silkworm gut sutures are then passed through the skin, superficial fascia, and aponeurosis, and the wound is lightly closed by them around the tube. The dressings are then applied and kept in position with a bandage, between the edges of which the tube projects. The patient is put into bed, and a vacuum pump is fixed on to the surface of the bandage in the manner shown in diagram 46. The descending tube of the pump is passed down to the bottom of the large tube in the bladder; it should only be a quarter of an inch in outside diameter, so as to leave a space between it and the outside tube, which acts as a collecting tube having perforations at its lower end. The upper end of the narrow tube is attached to a T-shaped glass tube (see diagram). By this means never more than one or two drachms of urine collect in the bladder—as soon as that quantity has accumulated, it is sucked out by the pump and is given no time to decompose. There are the additional advantages that the patient is kept dry and is much more easily nursed. It is not usual to change the dressing which is put on at the time of the operation for forty-eight hours. By fixing the pump in the manner shown, the patient can move in bed without interfering with its efficient action, and the feed and waste tubes can be led off the lower part of the bed, and are thus kept out of the patient's way. In arranging the pump there are one or two points which require care; the bottom of the reservoir should be only an inch above the level of the cross-bar of the T-shaped glass tube, as it is not necessary to have a high head of water, the pump acting well when the pressure is small. If the reservoir is high above the bed there is the possibility of flooding the bladder instead of draining it, in which case the patient has great annoyance from the cool flood, and he has the discomfort and trouble involved in the changing of the dressings. The stream through the pump should be extremely slow—just moving—as it is not necessary to have a rapid stream to cause a vacuum, and by keeping a slow stream the reservoir lasts many hours without requiring to be replenished. Twice in every twenty-four hours the bladder is washed out with warm boric lotion. The glans penis is washed with corrosive sublimate lotion (1–1000), and the tapered nozzle of a Higginson syringe is inserted into the meatus, and the boric lotion is then pumped slowly through the penile urethra into the bladder; this can be done without disturbing the patient or the dressings, if the stream of lotion is not too rapid, because the lotion is removed by the pump as fast as it enters the bladder. A pint of boric lotion is used at each washing. During the first twenty-four hours the lotion returns blood-stained, and small clots of blood are evacuated; these give no trouble as a rule, because the vacuum is capable of drawing a considerable-sized blood-clot through the tubes. If, however, the inner tube in the bladder should become blocked, it is a simple matter to remove it and wash out the clot and then replace the tube, without having to change the dressing. The pump is left in for eight to ten days. By this time the abdominal wound is granulated, and the urine is henceforth allowed to run freely from the bladder. The vesical washings are continued, but with more vigour, so that any phosphatic deposit or decolourised blood-clot may be removed. After the removal of the pump the patient has much more discomfort, because the urine is continually flowing from the wound and the dressings have to be changed frequently. The dressing consists of thick pads of wood-wool wadding, which absorbs large quantities of urine before any trickling over the skin of the patient takes place. It is important that the dressing should not be allowed to overflow, because when it does so the urine runs down over the pubes and between the thighs and the scrotum; if this happens, the skin becomes very sore and irritates the patient. To obviate this, the nurse keeps the skin anointed with oxide of zinc ointment, which she smears on with the fingers, or she applies it spread on strips of lint. The length of time between the operation and the passage of urine per urethram varies much, from a few days to a few weeks, and does not appear to have any relation to the size of the tumour which has been removed, nor to the condition of the bladder at the time of the operation. As a rule the suprapubic wound heals in about twenty-one days. The cessation of leakage from the wound is a source of great satisfaction to the patient, but, if he is not warned that the closure may not be permanent, his satisfaction is soon converted into despondency, because after the wound has been dry for some hours, even for twenty-four hours, during which time all urine is passed voluntarily per urethram, it usually begins to leak again, and may do so for a whole day or more. It again dries up and seems permanently healed, but the same disappointment may be repeated. As this is the usual course in which a suprapubic cystotomy wound closes, it is well to let the patient know what he may expect. By so doing he will not lose confidence in the surgeon, and he will be saved much misery, because the recurrence of the dribble from the wound

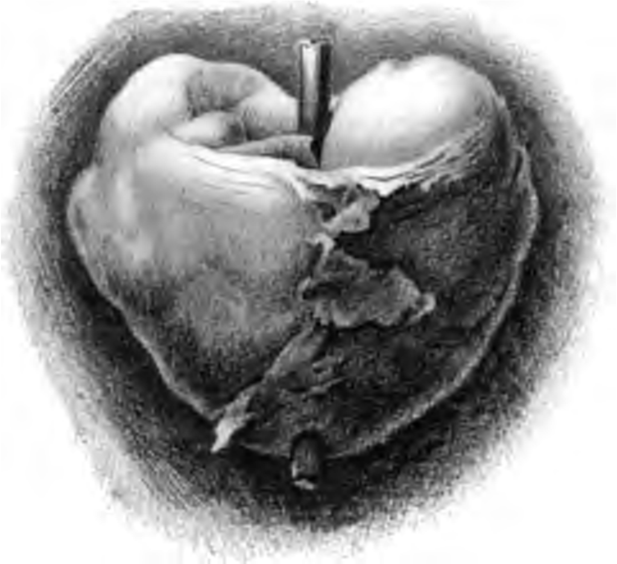

Fig. 45.

Adenomata removed in one mass by suprapubic Prostatectomy (from specimen 43, case 11).

often causes despondency out of all proportion to what might be expected.

For the first week after the operation the patient is kept on light diet, and is encouraged to drink barley water. When it becomes evident that he is going to make a good recovery, the best guide to diet is the patient's own appetite. As soon as he has recovered from the shock of the operation and from the effects of the chloroform, he should have his shoulders raised on a pillow, and the elevation should be increased as soon as possible with a bed-rest, as the ill effects of lying flat in bed may be more serious than the operation itself. It is very necessary that the bowels should be moved freely and regularly; to ensure this a dose of castor oil should be given on the second day after the operation, and a seidlitz powder in warm water each morning afterwards, if necessary. If there is marked cystitis, five grains of urotropin may be given three times in each twenty-four hours, and as this drug acts much more effectively in combination with an acid, it is well to give some acid phosphate of soda; half an ounce is dissolved in a pint of water, and the patient drinks this quantity in the course of each day. It is not necessary to keep him in bed until the suprapubic wound is healed; many patients may be allowed to sit in a chair before that time if they desire to do so. There are some patients to whom it is necessary that they should not be kept lying down, and who should be lifted out of bed, even though they object to being disturbed. It is never good to keep a decrepit old man confined to bed; he should be placed in his habitual surroundings as early as possible.

Perineal Prostatectomy is performed in a variety of ways. The patient is placed in the lithotomy position after having been prepared in the usual manner for perineal section; the skin having been shaved and thoroughly cleansed; purgatives having been given the day before, and an enema having been administered on the morning of the operation. The incision may be made in the mid-line of the perineum anterior to the anus, or it may be made transverse or horseshoe-shaped with the convexity of the incision forwards, at the back of the scrotum, and the ends terminating on either side of the anus. The last form of incision gives the best exposure. The incision is carried transversely, deep into the perineum, behind the posterior edge of the triangular ligament, and the rectum is pressed back from the posterior surface of the prostate. The next stage of the operation consists in giving the prostate a fixed support; this may be effected in several ways. The bladder may be opened above the pubes, and a finger introduced through the wound until it reaches the prostate and presses it down in the perineal wound, or a staff may be passed per urethram, or an incision may be made into the urethra below the prostate, and through the opening thus made the finger can be introduced until it reaches the bladder and so hooks the prostate down, or some instrument, such as an empty india-rubber bag attached to a tube, may be inserted through the hole in the urethra until it enters the bladder, when the bag is inflated and drawn upon by the tube, so that the prostate is pulled down into the perineal wound. Whichever of these methods is employed, the aim is the same, namely to bring the posterior surface of the prostate into a more accessible position. First one lobe and then the other is incised with a knife, and the tumours are enucleated. The wound is packed with gauze, and the after-treatment is that of any other perineal section.

Each of these modifications of the perineal operation has its advantages and disadvantages. When the finger of one hand is introduced above the pubes, a very thorough exploration of the prostate can be made, and the existence of an enlarged middle lobe can be ascertained; the prostatic tumours also can be thoroughly enucleated, because the finger in the bladder not only presses the prostate down towards the enucleating finger in the perineum, but the two fingers working together convey an accurate impression of what is being done. It has the disadvantage of being a much more severe proceeding than a simple perineal operation. A finger in the urethra has advantages, but the hand obscures the operation area, which is already of limited extent, and the finger cannot reach as far as is desired. A staff in the urethra does not bring the prostate down low enough into the perineal wound, but it does not necessitate an artificial opening in the urethra. An india-rubber ball, in the bladder, upon which traction can be exerted, has the double advantage of not obscuring the field of operation, and of drawing the prostate wall down.

To all perineal operations there is the drawback that by them a prominent middle lobe may not be reached, and its removal, therefore, may be impossible by this route.

There is a disinclination on the part of medical men to advise operative treatment of enlargement of the prostate, and patients are always willing that some less severe treatment should be fairly tried before they will agree to undergo an operation.

This aversion on the part of the patient is natural, but the

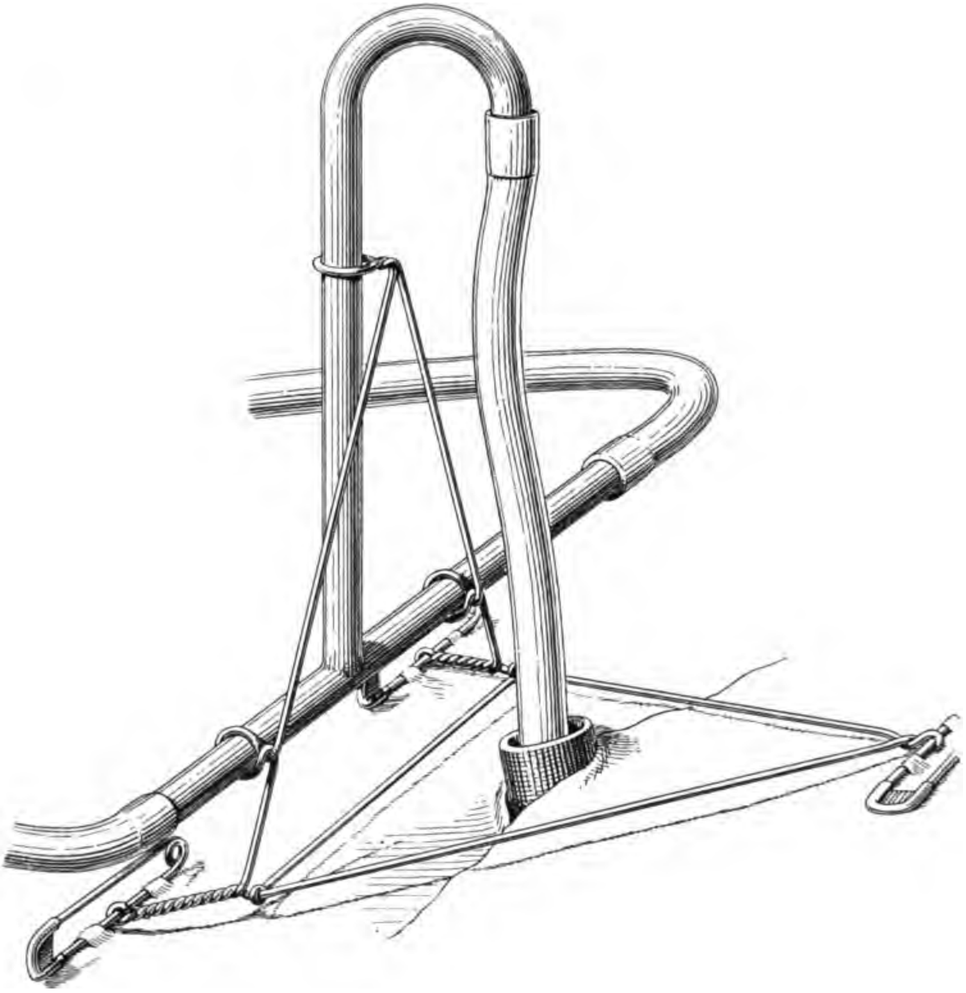

Fig. 46.

Vacuum Pump for suprapubic drainage.

disinclination of the medical attendant arises from a belief that perfect relief can be given by catheters, that the mortality following operations is great, and that most patients are too old. With regard to the belief that perfect relief can be given by catheters, it is true that many patients obtain such relief, but it is equally true that the vast majority sooner or later contract cystitis; many of these recover from attack after attack and continue to live, but it is in increasing discomfort and ill health—between the attacks their life is miserable, but during the attacks it is pitiable in the extreme. Every medical man has patients of this class who live for years, using perhaps a rough and dirty catheter, but who often have to summon him to relieve an attack of absolute retention. The very length of time which they continue to live impresses such cases on the memory of the medical attendant, but they are a small proportion of those who catheterise themselves. The greatest number die shortly after cystitis becomes established; and the cystitis is started by the catheter which is used to give relief. If the surgeon were to pass the instrument himself on every occasion when it was required, there could be little objection to recognising catheters as a most valuable form of treatment; cystitis would be a rare complication, and the other secondary results of enlargement of the prostate would be greatly delayed; but even under such imaginary conditions the treatment would be in no sense a cure; the prostate would not be affected, but would continue to enlarge until, in many cases, the surgeon himself would be unable to give relief even with the catheter, and an operation, though long delayed, would become imperative. As stated before, only a very small number of patients can possibly carry out treatment by means of catheters with the absolutely necessary care; in the case of the great majority of patients they enter upon catheter life with the greatest risk. Sooner or later cystitis is sure to follow.

With regard to the second reason for not recommending operative treatment, namely that the mortality following operations is high, there are objections to this. It is true that when a patient gradually succumbs after repeated attacks of cystitis, and after his relatives have known for long that he was suffering from a disease which would probably prove fatal, his death loses some of the more tragic features which it would have possessed if it had occurred soon after an operation; but it is not true that operations are followed by such a high rate of mortality as that which follows catheterism. After operations death may be sooner, but it is not so sure as it is when the patient resorts to catheters. The mortality following radical operations for the removal of obstructing tumours of the prostate is surprisingly small when the condition of the patients who submit to them is considered. Nearly all those who, at the present day, are operated upon are exceedingly bad subjects. They have, for the most part, suffered so long and so acutely that they express themselves willing to submit to anything, even at the risk of a fatal issue, rather than continue as they are. They are broken down in health from lack of sleep and from the ill effects arising from cystitis. Many of them have albumen in the urine, and some have diabetes. They spend their whole time in efforts to micturate or in passing a catheter. The bladder has been over-distended for long, and is apparently beyond the power of recovery. Yet even among such patients, many of whom are as old as eighty, there are cases of recovery, not only of general health, but of the over-distended bladder itself. The analogy of prostatic and uterine tumours has been noticed; there appears to be a likeness also in the history of the surgery of the two organs. It is now only a few years since abdominal hysterectomy was a very fatal operation. It was only performed upon patients who had large tumours, and whose general health had not seriously suffered; and even among those patients, those only were selected with whom other measures had failed; curetting of the uterus and removal of the ovaries were tried, and ergot was given, and if the patient obtained no relief from those measures, hysterectomy was resorted to. Patients were advised not to submit to the operation because the mortality following it was so high. At the present day the mortality of abdominal hysterectomy is reduced to the same low rate as that of other abdominal operations. It is recognised that if a patient who suffers from uterine myomata refuses to have hysterectomy performed, she runs a greater risk than if she consents to the operation; that it is serious to trust to curetting, oöphorectomy, and ergot, because, by the time these measures have been proved to be ineffectual, her health may have suffered so much that she will be in much worse condition to bear the major operation. That is to say, the mortality of hysterectomy has been reduced by two things: by improved technique, and by performing the operation before the tumours have seriously affected the patient's general health. The history of the surgery of the prostate has not reached the satisfactory stage at which that of hysterectomy has arrived, but it has advanced so far in the same direction that there can be no reasonable doubt that it will follow the same course. It will do so for the same reason, namely that patients will be informed that the various means of relieving symptoms, such as the use of catheters, though comforting for a time, do not remove the cause of the trouble, and will probably be active agents in making the symptoms worse; that the time occupied in their use is so much time lost, inasmuch as at the end of it their health will have been seriously affected, and they will not be so well able to bear a radical operation. The technique of prostatectomy will be improved, and patients will be operated upon before old age itself becomes a serious factor. No one who has seen the wholly satisfactory results of successful cases of prostatectomy can doubt that the radical operation will become the usual form of treatment of chronic enlargement of the prostate: that is to say, the usual treatment of such cases as arrive at the point when the choice lies between catheters and an operation. There is nothing in surgery more completely satisfactory. The patient who, perhaps for years, has never had a whole night's sleep, who has used a catheter night and day, with the attendant discomforts, who has feared to go far from home because of the lack of privacy desirable when using the catheter, who has had to neglect or give up his business, who has felt his health fail, and when he can no longer bear the pain and distress would rather die, after successful removal of the obstructing tumours is quickly rid of all his former trouble. He sleeps well all the night through, his appetite returns, and he can resume his work; he regains his independence and health; and the bladder itself, which had appeared to be irretrievably damaged, recovers its tone. Such a result may occur in one who is looked upon as an altogether unsuitable patient upon whom to perform any operation; and it cannot be doubted that by improvement in methods of operating, and by performing such operations upon men before they have almost ruined their health by temporising with catheters, the mortality following prostatectomy will be greatly reduced. The importance of operating early is illustrated in an unexpected manner. Patients with enlarged prostate may be divided into those who suffer from vesical calculus in addition to an enlargement of the prostate, and those who have no calculus in the bladder. The mortality after prostatectomy in these two classes of cases is very much less in those who have calculi than in those who have no calculi. The reason for this is that those who suffer from calculi have much more acute symptoms than those who are not the subjects of calculus, and, being in so much more urgent distress, they submit to operation at an earlier phase in the prostatic enlargement than they would if free from calculi.

Catheters should be reserved for the relief of absolute temporary retention of urine; for such patients as have the intelligence, leisure, opportunity, and means to carry out the treatment properly; and for those for whom, on account of extreme old age or other prohibitive reason, prostatectomy cannot be reasonably advised.

Whether suprapubic or perineal prostatectomy should be the operation, will depend upon the surgeon. The suprapubic operation has the great disadvantage that it cannot be performed by a surgeon whose hand is small, because the prostate cannot be brought within convenient reach of his finger. It has the further disadvantage that the surgeon does not see what he is doing—always a great defect in any operation. The results, however, are excellent. Perineal prostatectomy has the disadvantages, that it is performed in the perineum, and that as yet no means has been devised of thoroughly supporting the prostate.

Complications occurring after Operations.—*Hæmorrhage* immediately after the suprapubic operation is usual, but it is not in large amount as a rule. It comes from the torn small vessels in the substance of the prostate, and gradually ceases until on the second day the urine may not be blood-tinged. Sometimes, however, it does not diminish, but continues to soak the dressing. If such an event should occur, the source of the bleeding must be found and the hæmorrhage must be stopped at once. It will be found either in the suprapubic wound; in the bed of the prostate from which the tumours have been enucleated; or in veins of the prostate plexus. Before applying treatment to the prostate, it is well to make sure that the blood is not issuing from a vessel in the suprapubic wound; many such cases have occurred, and it saves much pain and shock to the patient if such a source of hæmorrhage be found at once. It is greatly to the disadvantage of the patient that he should be disturbed by repeated failures to check the hæmorrhage under the supposition that it comes from the prostate, and then have to submit to the additional pain incidental to its arrest in the suprapubic wound. If the hæmorrhage comes from the substance of the prostate—a rare event—it may be checked by slowly injecting a drachm of adrenalin solution down the penis. This ensures the solution reaching the wound in the prostate, it does not disturb the patient excessively, and it is very effectual. If the hæmorrhage does not arise in the suprapubic wound, and if it cannot be checked by the injection of adrenalin solution, but continues to issue from the wound in the same quantity, there must be a grave suspicion that it comes from a wound of the plexus of veins in the sheath of the prostate. This accident occurred in case 22, in which death took place directly from hæmorrhage fifteen hours after the operation. Hot lotion and adrenalin solution were injected per urethram; the wound in the prostate was plugged with strips of gauze, which arrested the bleeding for a short time, but never permanently. There was never copious hæmorrhage at any time; the blood slowly oozed. The patient was transfused, with temporary benefit only, and he died. At the post-mortem examination it was found that the enucleating finger had passed through the capsule of the prostate, on the left side, and had rent the sheath and so lacerated the vessels.

Abscess of the prostate may follow the operation of prostatectomy. Case 14 illustrates this. Suprapubic prostatectomy was performed on December 3, 1902. On January 23, 1903, there was evidence of cellulitis in the left side of the pelvis as felt per anum. On January 27 a large abscess was opened in the left side of the perineum, and the abscess opened spontaneously at the same time into the rectum, at a point almost out of reach of the finger. On February 13, 1903, the abscess had healed, and the patient went home. He is now in perfect health. The general symptoms were those of acute suppuration. The temperature was high and the patient very ill; as suppuration became established he had rigors and sweating. Locally the symptoms were: great pain in the perineum and rectum, which was radiated to the thighs; as the swelling increased, the mucous membrane of the rectum became œdematous, and he had constant desire to defæcate; this was succeeded by incontinence of fæces, and total inability to contract the sphincter ani, which became patulous. The abscess was freely drained and irrigated, and it slowly healed. It has had no ill effect on the result of the operation. It appeared to start in the connective tissue of the sheath on the left side of the prostate; upwards it followed the course of the veins in the pyramidal space external to the seminal vesicles, towards the internal iliac veins; downwards it spread in front of the rectal fascia to the perineum.

Calculus may form in the bladder after prostatectomy in cases in which there was no calculus before the operation. In cases 27 and 28 the patients made good recoveries from the operation, but returned subsequently with symptoms of cystitis and calculus in the bladder. In one case, the notes of which have been lost, there was a large phosphatic calculus free in the bladder, and much deposit of phosphates on the walls, which felt rough to the sound. In case 28 the patient returned five weeks after going home, and a soft calculus was removed; it was the size and shape of a large almond, and was composed of blood-clot thickly coated with phosphates, and appeared to be a calculus such as that which was found in the other cases in process of formation. This last observation, if true, emphasises the necessity of thoroughly washing out the bladder before the suprapubic wound becomes closed.

Pouches and saccules in the bladder may be a source of danger, as they cannot be cleansed or reached with the lotion during irrigation after the operation. In case 33 no calculus was detected in the bladder, although searched for by the finger, before proceeding to enucleate the tumours. After the first tumour had been removed, and when the index finger was reinserted, a calculus as big as a pigeon's egg was found free in the bladder; and on making further search a sacculus, which admitted a little more than the first phalanx of the finger, was discovered close to the right ureter; it was of the same shape as the calculus, and there appeared to be no doubt that the calculus had lodged in it. There were other sacculi of smaller size in the bladder-wall. The patient made a good recovery, and went home and appeared to have the prospect of being permanently rid of his urinary trouble. Some weeks afterwards he suffered from an attack of cystitis, and this occurred in spite of the fact that he had not used a catheter since his operation. It was then found that the urine varied much in appearance in the course of one act of micturition; at times it was fairly clear, and at other times it was very thick with a white deposit. The patient would take no care of himself, and he died six months after the operation, with evidence of severe cystitis and renal disease. No post-mortem examination was permitted, but the view was taken that the sacculus was the cause of the cystitis, and therefore indirectly of the patient's death. This suggests that marked sacculation of the bladder, when cystitis is present at the time of operation, is a serious complication, and should cause a less hopeful prognosis than would be given in the same case if sacculi were not found.

Reopening of the suprapubic wound some time after the operation occurs, if the operation has not been complete. This happened in cases 9 and 19. In case 9 there was a collar-like obstruction, and no attempt was made to remove a tumour, the operation being confined to cutting a channel in the posterior lip of the outlet of the bladder. The wound healed, and the patient went home able to pass his urine naturally. Twelve months after the operation he returned with a minute fistula, through which urine trickled above the pubes. He feared, and would not permit, any further examination, and preferred to remain as he was.

Case 19 was operated upon on August 17, 1903, but the adenomata were not removed. The patient recovered, and he regained the power of voluntary micturition; the reason being that though the tumours were not actually removed, yet the finger had almost enucleated them, and in process of healing the consequent scar tissue must have shrunk and so freed the passage; five months after the operation he returned with a fistulous opening in the lower part of the abdominal cicatrix, and almost all the urine passed through it. On February 19, 1904, the fistulous opening was enlarged so as to allow the index finger to explore the bladder. The adenomata were removed as far as possible, and the patient can now pass his urine per urethram, but the operation was very difficult on account of the density of the prostatic cicatrices.

Stricture.—Much interest has recently been taken in the question whether the entire prostate can be enucleated by the finger through a suprapubic incision; and whether, in the operation known as suprapubic prostatectomy, the entire prostate is so removed. The answer is sought in different directions; by reference to normal anatomy and by examination of pathological specimens, both those upon which operations have and have not been performed. The evidence of anatomy proves beyond any doubt that it is a physical impossibility to remove a normal prostate without, at the same time, damaging the sheath; and when the sheath is torn the veins of the prostatic plexus also must of necessity be torn. Many of those who grant that the normal prostate cannot be enucleated without laceration of the sheath, yet hold that it may be so removed when it is enlarged. Cases 6 and 22 would indicate that this cannot be done.

In case 6, to which reference has already been made (page 90), the finger passed external to the capsule of the prostate, and therefore into the connective tissue of the sheath, the veins of which were torn; such free hæmorrhage occurred that it was necessary to obtain a view of the laceration, and this was secured by enlarging the incision in the bladder and seizing the prostate with volsella. The enucleation was completed, and the patient made a good recovery. Three months after the operation he returned with an impassable stricture, and he now has a permanent drain in the bladder. This patient therefore shows that though the entire prostate may be enucleated, yet this cannot be done without laceration of the prostatic plexus of veins; and it also shows that if the hæmorrhage be arrested and the patient survive, yet total extirpation of the prostate is followed by incurable stricture; a result which can scarcely cause surprise. In case 22 the same accident happened, but the hæmorrhage at the operation was not excessive, and the need did not arise to expose the prostate, as occurred in case 6; the complete extirpation was not therefore performed, but the patient died of hæmorrhage because the finger had passed outside the capsule. If a fatal hæmorrhage followed this limited wandering of the finger, it cannot be doubted that the mortality following total prostatectomy, in which the finger must pass everywhere beyond the limits of the capsule, would be very great. Even if the patient escaped death from hæmorrhage, he would not escape a traumatic stricture. In contrast to this is the fact that hæmorrhage is not a very serious factor in suprapubic prostatectomy, and stricture is almost unknown, even in cases where the entire prostatic urethra is known to be removed. Case 1, fig. 41, supports the contention that the operation called total extirpation is not in reality what it is supposed to be. In this case it was thought that the entire prostate had been removed; the specimen had the appearance of a complete prostate, and the urethra was certainly removed with the tumour; the specimen was not in two portions: it completely surrounded the urethra. The appearance of the enucleated mass was not the only thing which led one to suppose that the whole prostate had been removed. When the finger in the bladder examined the bed from which the tumour had been removed, it felt that the tissues between it and the finger in the rectum were so thin and supple that they could not represent much more than the rectal wall. Accordingly it was not doubted that total extirpation of the prostate had been effected. The patient died, and a post-mortem examination was made, and as it was not clear that total extirpation had been performed, a piece of the tumour and a piece of the bed from which it had been removed were sent to a research laboratory for a report upon them; the only question which was asked was what was the nature of each specimen. No information was given which could disclose the object of the inquiry. The report stated that the tumour was an adenoma of the prostate, and the bed was composed of compressed prostatic tissue. This was in agreement with the many independent reports which have been made upon other cases, and it is also supported by what is found post mortem in any case which is examined after enucleation of prostatic tumours. A complete bed is always found composed of prostatic tissue, and the undamaged sheath of the prostate is always external to the bed.

In two cases, Nos. 27 and 31, the patients returned in great alarm, twelve months after the operation, because of sudden severe hæmorrhage. Each patient had been living free from urinary trouble since the operation, and each had a severe attack of hæmaturia, which came on during the night without any warning. They came with samples of urine in bottles, and it was composed chiefly of blood. They had been so alarmed that each had come into town by the earliest train in the morning. When seen, each of them was asked to pass his water, which he did without difficulty, and it was almost free from blood. No further trouble occurred in either case. Case 31, however, had a similar attack a year later, and I have heard since then that neither of these patients has had a return of this distressing symptom. The length of time—one and two years respectively—since these attacks precludes any question as to the possible malignant nature of the cases.

Acute Prostatitis.—Acute prostatitis is an affection which may arise at any time during the active adult life of the gland. It does not occur in children, nor in very old men, but the reason of this may be found in the cause of the disease rather than in the condition of the prostate itself. It cannot occur until septic organisms have been introduced into the gland, and these almost invariably gain an entrance during the active stage of gonorrhœa. Gonorrhœa is the chief cause of acute prostatitis, the organisms which set up acute urethritis spreading up the urethra until they enter the ducts of the prostate itself, and there set up the same process of inflammation which they cause in the urethra. Septic organisms may also occasionally be introduced by instruments, but this is a very exceptional cause of acute prostatitis; it occurs in elderly men who use catheters for the relief of symptoms due to enlargement of the prostate, and who have by that means brought about an attack of cystitis; during such an attack the prostate may become acutely inflamed.

Symptoms.—In elderly men the symptoms of acute prostatitis are exaggeration of those due to enlargement of the prostate with cystitis. They are not so acute as in the prostatitis which occurs during an attack of gonorrhœa. On the contrary, the existence of acute prostatitis in elderly men may not be recognised until the formation of an abscess discloses the fact that the exaggeration of the patient's trouble has not been due to cystitis and congestion of the mucous membrane of the prostatic urethra only, but to an acute inflammation of the gland itself. The uncomplicated symptoms of the affection are seen in those who develop an acute inflammation of the prostate in the course of an attack of gonorrhœa. In these patients gonorrhœa may be pursuing its normal course, when, apparently without any cause, all the symptoms become exaggerated and the patient becomes very ill. The discharge of pus from the urethra continues. There is a constant desire to pass water, and the act of micturition is accompanied by much pain; soon the pain becomes incessant and does not excite the same desire to micturate; it is more of an aching character, which becomes so severe that it overshadows the desire to pass water. The effort to micturate increases the pain, which is radiated in the perineum and on to the inner side and back of the thighs and into the rectum. Sitting becomes painful, and the patient takes to bed because he has less pain when lying down. The temperature rises, and he has the constitutional symptoms associated with septic inflammation. He experiences more and more difficulty in passing his water, having to strain; and this increases the congestion of the urethral mucous membrane, which in its turn adds to the difficulty and pain of micturition, and is apt to culminate in an attack of absolute obstruction, with retention of urine. The patient's condition is then one of extreme distress. He cannot resist the call to micturate, the attempt to do so causes the bladder to contract forcibly, and the pain of retention is added to that of acute prostatitis. The patient strains until there may be involuntary passage of mucus or fæces per rectum, and he rapidly becomes very ill, unless relieved. These symptoms last for several days, at the end of which time they may slowly subside, or they may pass into those of chronic prostatitis; or they may terminate in those of an acute abscess of the prostate. Rectal examination of an acutely inflamed prostate is an excessively painful operation, and after the first necessary examination it should not be repeated, unless for the purpose of determining the presence of an abscess. In such an examination the prostate is found to be round, swollen, and extremely tender, and projecting into the rectum. The arteries on its surface can be felt pulsating, and the mucous membrane of the rectum feels soft and rather swollen.

Treatment.—The patient must be kept warm in bed and be dissuaded from making incessant attempts to pass his water. A purgative must be given and sweating induced, so as to reduce the amount of urine which must be passed. Hot applications to the perineum must be made, and they give some relief. Morphia is necessary to relieve the pain; and it need not be given in the form of a suppository, as the rectum is excessively tender, and the drug is not more effective when so administered. Bicarbonate of potassium and tincture of hyoscyamus may be given also, with the object of diminishing the acidity of the urine and reducing the spasmodic contraction about the first part of the urethra. If retention of urine is present, it must be relieved with a catheter. In performing such an operation it is impossible to avoid carrying pus from the urethra into the bladder with the catheter: fortunately, this is not followed by acute cystitis. The disease which causes the retention itself subsides in the course of a few days, and the conditions so favourable to cystitis are thus removed. The bladder is not sacculated, nor has it been weakened by chronic over-distension, as occurs in the subjects with chronic enlargement of the prostate; the mucous membrane of the bladder is also healthy, and its epithelium is intact; consequently, as soon as the retention is relieved the bladder can empty itself completely, and there is not sufficient time for the septic organisms to effect a lodgment; there are no saccules in which they can develop in stagnant urine, nor abrasions of the epithelium through which they can effect an entrance into the mucous membrane. A soft small-sized catheter must be used. No. 7, English scale, india-rubber catheter is a suitable instrument. It must be passed with the same care as in a case in which there is no urethritis. The catheter must be sterilised and the end of the penis cleansed, and the operation must be repeated as often as it may be necessary. The bladder must not be allowed to become over-distended.

ILLUSTRATIVE CASES OF ACUTE PROSTATITIS

Resolution—Recovery

J. S. Male, aged 43; admitted July 27, 1903.

History.—Four weeks before admission acquired gonorrhœa. He was getting well from this and went to camp. While there he commenced to have great frequency of micturition, which act was very painful. While having his bowels moved he had great straining and desire to micturate, but was unable to pass water.

On admission he had a large amount of residual urine like an ordinary enlargement of the prostate.

Per rectum.—There is a big mass in the pelvis like an enormously enlarged prostate. The mucous membrane over this is very œdematous.

Treatment.—Catheterism. Patient kept in bed. Milk diet. Hot fomentations.

Patient went home one week after admission, quite well; no mass to be felt per rectum.

J. McL. A young man, aged 26, had suffered from gonorrhœa of *two weeks' duration. Three days before being seen* he began to have great difficulty of urination, requiring catheterisation. When seen he had retention of urine, and was in great distress and pain, the pain being increased by movement or by standing up or walking, He had rectal tenesmus. A No. 10 soft rubber catheter passed with ease up to the prostatic urethra; here difficulty was experienced and much pain caused by its passage on into the bladder. The catheter drew off 12 oz. of clear urine.

Examination per rectum.—Prostate enlarged and tender on pressure, which caused an intense desire to micturate. No œdema.

Treatment.—Patient was kept in bed on a milk diet, morphia was administered to relieve the pain, and hot perineal stupes applied. Catheterisation was regularly performed, and the patient made an uninterrupted recovery, being up and about in three weeks.

Acute Abscess of the Prostate.—This occurs, as a rule, in the later stages of acute prostatitis, but it occasionally follows injury by a lithotrite or catheter, and it may follow the operation of prostatectomy.

The symptoms are the same as those of acute prostatitis, namely pain, difficulty of micturition, and constitutional disturbance; but there are, in addition to these, symptoms due to implication of the rectum. The formation of an acute abscess is accompanied by rigors, and sweating, and general increase of the constitutional symptoms. The patient complains more of pain in the rectum and of incessant desire to defæcate, and if a rectal examination be made, it will be found that there is great swelling, not of the prostate only, which may not be definable, but of the cellular tissues in front and at the sides of the rectum. The prostate may be lost among the swollen tissues around it. The rectal mucous membrane will be found to be œdematous, and this may extend as far as the finger can reach, or it may be confined to one side only of the prostate, or it may only be felt over the prostate itself. When the swelling is great, it may so far implicate the rectal wall as to affect the sphincter ani and cause incontinence of fæces. It may be that no fluctuation can be felt, but the course of the symptoms and the occurrence of rigors and sweating, with the presence of œdema of the rectum, are sure indications of the presence of pus. The abscess may be felt to be pointing high up in the rectum on either side.

Such an abscess will point in different positions. It may open spontaneously into the urethra at the junction of the membranous and prostatic portions; or it may open in the perineum, or in the rectum; or it may open into both the urethra and the rectum, with the consequent formation of an urethro-rectal fistula. A position in which an abscess may open is just beyond the reach of the finger in the rectum, on one side or the other, the pus appearing to have followed the course of the veins and to have reached the rectum in consequence of the middle hæmorrhoidal veins uniting with those from the bladder and prostate.

Treatment.—This is the same as that of acute prostatitis. An abscess must be opened in the perineum, and thus an attempt be made to avoid a fistulous opening into either the urethra or the rectum. It frequently happens that an abscess is opened unintentionally during the passage of a catheter to relieve retention; and still more frequently the abscess bursts spontaneously either into the rectum or the urethra. The symptoms are immediately relieved and the abscess slowly heals.

ILLUSTRATIVE CASE OF ACUTE PROSTATITIS—PROSTATIC ABSCESSES—MEDIAN PERINEAL SECTION—DRAINAGE—URÆMIA—DEATH

H. C. Male, aged 49.

History.—*Ten weeks before admission* patient acquired gonorrhœa.

Seven weeks ago began to have frequent and difficult micturition.

Three weeks ago.—Scalding pain on passing water; stream had no force, and urine was only passed in drops. Great pain in the perineum. Sense of weight and slight pain on defæcation. The urine was cloudy and foul-smelling.

Two weeks ago.—Complete retention, relieved by the catheter passed twice daily. On the day of admission the doctor could not relieve the retention and sent him to hospital.

On admission.—General condition fairly good; temperature, 104° F.; pulse quick, tongue dry; he was suffering great pain, which was immediately relieved by catheter.

Per rectum.—Tender swelling in the position of prostate.

Examination of Urine.—Specific gravity, 1012. Alkaline, very putrid, containing a large quantity of pus and albumen.

After-progress.—During the next few days he was treated by regular catheterisation and irrigation of the bladder with hot boric lotion; but despite these measures his urine still contained a large quantity of pus, and, moreover, he was developing marked drowsiness and slight symptoms of uræmia.

Operation.—Median perineal section. Abscess cavities found occupying both lobes of prostate gland. Good deal of pus evacuated on incising these. Foul-smelling urine from bladder. Bladder and cavities in prostate drained through the perineal wound.

Progress after operation.—Became very drowsy, with twitchings, scanty urine, and died two weeks after operation from acute uræmia.

Necropsy.—Specimen 34, showing large abscess of prostate.

Kidneys.—Presented appearances of acute septic nephritis.

Calculi in the Prostate.—Minute particles of calcareous matter are so common in the prostates of elderly men as to be almost normal structures, but occasionally they become of such size as to cause irritation and much inconvenience. They are lodged in small cavities, and may be present in large numbers; even so many may be present that they can be felt per rectum to rub one upon another. They do not, as a rule, give trouble, unless they are associated with inflammation, when they cause increased frequency of micturition, with a burning sensation during the act and some sharp pain at the close. The patient does not feel that he has completely emptied his bladder. The frequency occurs both by day and by night, and causes much annoyance to the patient, who may otherwise be in perfect health. Anything which can favour congestion of the prostate aggravates the symptoms, such as horse exercise, alcohol, highly flavoured food, coffee, cigars, cold, and constipation.

Treatment consists in avoidance of anything which is known to aggravate the symptoms. If there are palpable calculi, they may be removed through a perineal incision.

It occasionally happens that a small vesical calculus finds its way into the prostatic urethra, and there sets up symptoms. Such a calculus may attain a larger size, in which case the symptoms are not so acute as with a small calculus. With a small stone the patient has great frequency of micturition, and more or less constant pain, which is much worse during and after the act of micturition. There is a sense of weight or of actual pain in the perineum, and there may be blood in the urine. With a large calculus the only symptom may be incontinence of urine, but the patient may look ill and be worn out by loss of sleep; in children there may be chronic prolapse of the rectum. The symptoms are not relieved by lying down. Examination per rectum will only detect such a calculus when of large size. A sound detects the stone not by causing a click which may be heard, but by the sensation of rubbing upon some hard surface.

Removal of the calculus may be effected by suprapubic cystotomy, if the stone is large; or by perineal section; or by pushing the stone back into the bladder, and then crushing it with a lithotrite, and removing the fragments with an evacuator.

Tubercular Disease.—This is rarely a primary disease of the prostate. As a secondary condition to disease of neighbouring organs it is not infrequently seen. Tubercular ulceration of the bladder spreads down the urethra, and so invades the prostate, which it may almost completely destroy, causing large caseating nodules, which break down and leave ulcerating cavities communicating with the urethra; or these nodules may form large abscesses, which do not open into the urethra, but spread towards the rectum or the perineum; or both of these events may happen, in which case a fistulous track is left, communicating with the urethra on the one hand and either the rectum or perineum on the other. The same process occurs when the disease of the prostate is secondary to that of the vesicles.

The symptoms are those of irritation of the prostatic urethra, namely increased frequency of micturition, both by night and by day, with pain during the act; some discomfort and feeling of weight in the perineum and behind the pubes, aggravated by walking about. If there is ulceration, particularly in cases of extension from the bladder, the symptoms are extremely distressing, and similar to those in a patient with vesical calculus and cystitis. Hæmorrhage is a marked symptom, and may be in large amount. It is seen at the beginning of the stream, and it is present in the urine passed at the end of the act of micturition. It may be in such amount as to coagulate in the prostatic urethra, and there act as a plug, causing strangury with retention of urine. When a patient has advanced to the stage of ulceration he shows evidence of tubercular disease in his general condition, and if hæmorrhage occurs frequently, or in large amount, he rapidly declines.

The treatment consists in giving rest to the bladder by cystotomy, either suprapubic or perineal, and constitutional treatment on the general principles applicable to tubercular disease.

Chronic Abscess.—This is generally due to tubercular disease, and is rarely a sequel of chronic prostatitis. The patient may not complain of any alteration of his symptoms in the course of his sufferings from tubercle. It may, even when not suspected, be found of considerable size during an exploratory examination of the rectum, the sweating at night and increased feebleness of the patient being attributed to general advance of the tubercular disease.

Chronic abscess may occur in the subject of chronic pyæmia, or it may complicate chronic cystitis; in both of which conditions the pus may accumulate in large quantity before any symptoms may distract attention from the primary disease.

The patient may complain of increasing discomfort in the perineum and during defæcation; or he may have increasing difficulty in micturition, with even absolute retention, when the attendant will discover the abscess in the course of his examination, or he may rupture the abscess when passing a catheter to relieve the retention of urine.

Treatment consists in opening and draining the abscess in the perineum, keeping the wound scrupulously clean, and attending to the general health of the patient.

Malignant Disease.—The prostate is not often attacked by either sarcoma or carcinoma. When it is so attacked the symptoms are indistinguishable from those of chronic enlargement. There are, however, even at the outset of such cases, certain symptoms which lead to suspicion.

Sarcoma.—The symptoms of chronic enlargement of the prostate occurring in a patient under the age of forty should raise suspicion that he is suffering from sarcoma. The history and the facts ascertained by examination may be typical of chronic enlargement, but no decided opinion should be given until the lapse of a few weeks, by which time the rapid increase in the size of the growth will have made the diagnosis clear. The following case illustrates this:

SARCOMA OF PROSTATE

J. B. Male, aged 32, admitted February 13, 1903.

History.—*Six weeks ago* urinary trouble commenced with a frequent desire to micturate and some pain. Finally he had an attack of retention of urine, which was relieved by catheter, but which was followed by other attacks. He was admitted during one of these attacks, which had lasted two days.

On admission looked fat, pale and unhealthy. He complained of but little pain, though he had a marked sense of distension.

Local.—His abdomen was much distended, from the pubes to above the umbilicus, by a swelling which looked and felt like a seven months' pregnant uterus. Some pus escaped from the urethra.

On attempting to pass a catheter free bleeding and escape of pus occurred as soon as the prostatic urethra was reached, but no urine could be obtained.

Operation (Feb. 16, 1903).—Bladder was tapped suprapubically and several pints of foul urine were drawn off. A tumour still remained, which was thought to be a prostatic growth. Exploration from the rectum with a syringe drew off only blood.

The bladder was now opened suprapubically for permanent drainage. An enormous mass projected into the bladder at the trigone, and examination of this with one finger in the bladder and another in the rectum showed it to be fixed to the left pelvic wall. A small tag which was found in the bladder was examined microscopically, and proved to be a spindle-celled sarcoma with myxomatous change.

March 26, 1903.—Patient exceedingly ill. Some fæces voided unconsciously, but no flatus. Vomiting for last three days. Abdomen much distended. Urine scanty.

Examination per rectum showed that the growth had increased greatly in size, and was now breaking down into the anterior wall of the rectum, so that portions of it came away on the examining finger.

The patient died during the night.

Necropsy.—A small amount of free fluid was in the belly. The sigmoid flexure of the colon was enormously distended and congested, being at least four inches in diameter. It appeared to fill the whole abdomen as it lay in front, over the intestines and stomach. The cæcum was also much distended, the descending colon least so. There were a few flakes of lymph on the transverse colon.

The growth sprang from the prostate, filling the whole true pelvis, and projected up into the false pelvis, carrying the bladder upwards and in front of it (Specimen 38). Some of the growth was fungating through the suprapubic incision, and on opening the bladder it appeared as a huge polypus. Both ureters were pressed on and dilated, and the kidneys were hydronephrotic. Below, the growth had burst through its capsule, and on the left side had come through the thyroid foramen with the obturator vessels. The pelvic veins were much enlarged, and several were in a state of thrombosis. There were a few nodules of growth on the pelvic peritoneum, but no enlarged glands were discovered. Both lungs contained masses of growth.

Microscopically both the prostatic and lung tumours were spindle-celled sarcomata.

Carcinoma.—There is a general suspicion on the part of surgeons that carcinoma of the prostate is more common than is believed to be the case. I have attended three patients whose symptoms did not lead one to suspect other disease than chronic enlargement until the report of the microscopic examination disclosed the fact that the growths were carcinomatous. In each case suprapubic prostatectomy was performed in the usual way, and the two patients who recovered have not shown any symptoms to lead one to suppose that they are suffering from carcinoma. The time which has elapsed since the operation in each case is twelve months and six months respectively. The prostate may be invaded by epithelioma secondary to the same affection of the bladder, in which case the symptoms arising from the disease of the prostate are of secondary importance to those produced by the primary growth. It is an extremely painful disease, and the patient becomes worn out with pain, lack of sleep, and loss of blood. He makes constant efforts to micturate, with great increase of pain at each attempt.

The treatment consists in relieving the pain and supporting the strength. Pain may be relieved by draining the bladder above the pubes, and by the administration of morphia. This operation rids the patient of the necessity to be constantly trying to pass his water, and allows him to obtain long hours of sleep. The morphia must be given in sufficiently large doses to give relief, and the doses must be increased or diminished as necessity requires.

At present no satisfactory means of radical cure have been devised.

ADENO-CARCINOMA OF PROSTATE—SUPRAPUBIC PROSTATECTOMY—DEATH

J. M. Aged 65, admitted September 16, 1903.

History.—Eight months ago illness commenced with frequency of micturition, with inability to completely empty the bladder, only a little urine passing each time. The act of micturition was preceded by great pain in hypogastrium.

Eight weeks ago commenced 'catheter life'; this has continued until the day of admission, when he had complete retention of urine, which could not be relieved by the catheter; accordingly patient was sent to hospital.

On Admission.—Fair general condition.

Local.—Bladder distended up to umbilicus; complete retention of urine, relieved by catheter.

Urine.—Specific gravity, 1010. Acid. No albumen.

Per rectum.—Prostate enlarged; at the right side of the middle line there is a prominence about the size of a walnut. The gland is elastic and is movable.

Operation (Sept. 26, 1903).—Bladder opened by suprapubic route. Prostate enucleated with very great difficulty by the finger. Suprapubic drainage tube.

Pathology.—Small hard nodules, size of peas, scattered in submucous tissues in the neighbourhood of the internal meatus. The prostate has the characteristics of a scirrhus.

Microscopical Report of Growth.—Adeno-carcinoma. In parts there are small papilliferous cysts.

Patient died a few days after operation. There was no necropsy.

LIST OF CASES OF PROSTATECTOMY

No.	Name	Age	General Condition before Operation	Local Condition before Operation	History	Urine	Operation and Date	After-Progress and Results
1	O. D. Specimen 45 Drawing 41.	68	Thin elderly man—poor. Thickened arteries.	Complete retention of urine. *Per rectum*— Prostate much enlarged and very hard. 20 oz. blood and urine withdrawn by catheter.	*Five years' trouble.* Marked frequency and dribbling. *Four attacks of retention* of urine necessitating catheterisation: admitted to hospital during the last attack.	Alkaline, ammoniacal. Contains albumen and good deal of blood. Extreme cystitis.	7/8/01. *Suprapubic Prostatectomy.* Middle lobe removed by cutting-forceps. Both lateral lobes removed by finger with difficulty. *Prostatic urethra removed*— Vacuum pump drain.	*Died same night.* *Necropsy.*—Bladder sacculated and contracted. Area from which prostate was removed quite smooth. An adenoma 1" in diameter left on right side. *Microscopical examination of part removed* = adenomata. *Microscopical examination of bed left* = thinned-out prostatic tissue. *Kidneys.*—Interstitial nephritis with septic pyelo-nephritis.
2	F. F. Specimen 42	59	Healthy and in good condition.	Complete retention of 14½ hours duration. *Per rectum*— Prostate enlarged. No catheter could be got into bladder.	*Twelve months'* great frequency of micturition: every two or three hours day and night. Micturition also difficult and painful. *Three months ago* first attack of retention Admitted to hospital during second attack of retention.	—	31/5/02. *Suprapubic Prostatectomy.* Whole of prostate and prostatic urethra removed by enucleation. Vacuum pump drain.	12/6/02. Pump removed. 5/7/02. Nearly healed; all urine by penis. Left hospital. 16/7/03. Quite well, no urinary symptoms; does not get up at night to micturate.
3	J. W. Specimen 51	65	Very good. Temperature and pulse normal.	Unable to pass any urine himself; it is drawn off by catheter night and morning. *Per rectum*— Prostate felt enlarged.	*Four years ago* first noticed great frequency of micturition. No pain. No hæmaturia. Lately almost constant desire to micturate, with inability to empty bladder.	Sp. gr. 1010. Acid. No albumen. No sugar. No pus. No blood.	14/6/02. *Suprapubic Prostatectomy.* Large adenoma from left lobe and several small adenomata from right lobe, shelled out by finger; urethra left intact. Vacuum pump drainage.	18/7/02. Pump removed. 18/8/02. All healed; all urine passed by penis. Left hospital.
4	T. T. Specimen 44	63	Fair condition. Tongue coated. Sleeps badly. Temperature 99°·4 F.	Complete retention of urine. For twelve days before operation catheter regularly passed and bladder irrigated.	*For one year* has had great pain and difficulty in urination, with constant desire to micturate. *On admission* (16/7/02) retention of urine. Catheter drew off 42 oz. of urine mixed with blood.	Sp. gr. 1012. Neutral. Contains albumen. Little blood No sugar.	28/7/02. *Suprapubic Prostatectomy.* Prostate enucleated with finger in three lobes—right, middle, and left. Pump drainage.	29/8/02. Has been very ill until now with threatening uræmia; slightly better. Sent home. 19/2/03. General health improved; no difficulty in urination; wound healed. *April* 1903. Steadily improving; is working. *Sept.* 1903. Still improving.

LIST OF CASES OF PROSTATECTOMY (*continued*)

No.	Name	Age	General Condition before Operation	Local Condition before Operation	History	Urine	Operation and Date	After-Progress and Results
	J. D. Specimen 52	58	Good.	*Per rectum*— Prostate felt hard and moderately enlarged.	*Twelve months ago* first attack of retention; relieved by catheter. Since then great frequency of micturition: every hour night and day, but no pain. Got gradually worse despite catheter life and irrigation of bladder.	Sp. gr. 1015. Acid. No albumen. No sugar. No blood. No pus.	23/8/02. *Suprapubic Prostatectomy.* Bladder sacculated and trabeculated. Prostate—collar variety. Adenomata removed by finger in two masses which met behind urethra. *Half an inch of prostatic urethra removed.* *Small adenoma on left side was left behind.* Pump drainage.	14/9/02. Wound healed. 12/8/03. No trouble of any kind; sleeps the whole night through undisturbed; general health excellent.
6	R. M. Specimen 40	62	Florid-looking man. Pulse 78, high tension. Temperature 98° F.	*Per rectum*— Hard firm prostate felt. Both lateral lobes enlarged.	*Two years' history*— Great frequency by day. Worse at night (every 15 minutes). Good stream, but no projection. Marked dribbling.	Sp. gr. 1020. Alkaline. No sugar. Trace of albumen. *Residual*— 20 oz.	1/10/02. *Suprapubic Prostatectomy.* Whole prostate with prostatic urethra, part of seminal vesicles, and fragments of levator ani muscle removed by enucleation with scissors. Rubber drainage tube.	23/11/02. Epididymitis and orchitis. 15/12/02. *Tight stricture in deep urethra impassable to instrument.* 16/12/02. Stricture dilated. 12/1/03. No control; constant dribbling. Perineal section performed. Permanent drain.
7	R. B. Specimen 50	60	Very rheumatic subject.	*Per rectum*— Prostate hard, and feels much enlarged. It is not tender. Bladder only holds 8 oz. urine.	*Ten years'* duration of symptoms. *Three years'* catheter life.	Sp. gr. 1020. Alkaline. Much albumen, pus, and mucus. *Residual*— ℥j.	20/10/02. *Suprapubic Prostatectomy.* Vesical calculus removed. Large adenoma shelled from right lobe; small one not removed from left lobe. Pump drainage.	10/1/03. Perfectly well; sleeps all night undisturbed. No urinary symptoms whatever. 10/3/04. In perfect health.
8	J. P. Specimen 41	75	Good.	Complete retention of urine.	No note.	No note.	8/11/02. *Suprapubic Prostatectomy.* Prostate shelled out, and portion of prostatic urethra removed with it. Pump drainage.	22/12/02. Left hospital, passing all urine per urethram. *Re-admitted* 11/5/03 with STRICTURE URETHRÆ. Suprapubic wound open and leaking. Gradual dilatation of stricture by bougies. 23/5/03. All urine by penis; suprapubic wound nearly healed. *Re-admitted* 14/7/03. All urine by suprapubic wound. 19/10/03. Left hospital; wound not healed; micturition every half-hour. *Uræmic.*

9	H. T. H	57	Fairly good.	*Per rectum*— Prostate enlarged. Seminal vesicles enlarged.	*Twelve months ago* first symptom. Dribbling of urine and frequency of micturition. No pain. Had to get up once or twice through night. These got much worse, and *a fortnight ago* began to have great pain in hypogastrium, and started catheter life.	Sp. gr. 1015. Alkaline. Smells badly. Contains albumen and pus. *Residual*— 4½ oz.	28/11/02. *Suprapubic Prostatectomy.* Enlargement of prostate is 'collar' variety, surrounding internal urinary meatus. With gouge forceps a groove was cut in posterior ridge, and a free channel made. Index-finger could then be easily passed into prostatic urethra. Pump drain.	Patient left hospital before wound was quite healed. Returned in a few weeks passing his urine by urethra, but nocturnal micturition continued. *January* 1904. Wound broke open. Patient refused further treatment.
10	M. H.	52	No note.	No note.	*Fourteen weeks ago* sudden retention of urine: catheter passed. Since then no retention. *Eight weeks ago* passing 'grit' and foul-smelling blood in urine. Pain at end of penis in making water. Every half-hour had desire to micturate, and has almost constant pain in penis.	No note.	3/11/02. *Suprapubic Prostatectomy.* Large quantity of phosphatic calculous matter removed from bladder. Large adenomata shelled out, one from each lobe. Rubber-tube drainage.	14/12/02. Suprapubic wound healed: passing urine by penis without trouble. 22/5/03. Perfectly well; no need to get up at night to micturate.
11	J. A. Specimen 48	63	—	*Per rectum*— A large prostate is easily palpable, regular in outline, and hard.	*Fourteen years ago* first attack of retention relieved by catheter. *Three years ago* another attack, which lasted six weeks. *Five weeks ago* again retention; catheter tied in for nine days. *During last month* very frequent micturition, and catheterisation difficult.	No note.	15/11/02. *Suprapubic Prostatectomy.* Horseshoe-like mass, embracing opening of urethra. This mass was shelled out. Pump drainage.	20/11/02. Cathcart removed. Patient recovered from the operation and went home. Not seen since.
12	G. C. Specimen 57	72	Healthy. Temperature normal; pulse, 72 Artery very atheromatous. Tongue coated.	Very frequent micturition; cannot hold urine for any length of time. Pain in penis during micturition. *Per rectum*— Prostate enlarged; smooth, and rounded.	*Fourteen weeks ago* illness commenced with ineffectual frequent micturition. There was complete retention at outset, and he had to pass a catheter. With the frequent micturition still he could not empty bladder completely. *For first three weeks* he passed a large amount of glairy mucus.	Sp. gr. 1022. Alkaline. Contains albumen. No pus or blood. *Urea*— 7½ gr. per oz. *Residual*— 46 oz.	9/12/02. *Perineal Prostatectomy.* Median perineal incision 3 inches long. Parker Sym's retractor inserted through cut urethra into bladder and prostate pulled down. Capsule of prostate incised and adenomata shelled out in several pieces. Large rubber drainage tube.	30/12/02. Began to pass urine by penis. 12/1/03. Nearly all urine by penis. Bladder washed out daily. Urine sp. gr. 1012. Alkaline. Albumen. *Urea*, 2 gr. per oz. 20/1/03. Left hospital. Perineal wound healed; has to urinate frequently; can retain it for one hour at night. 3/7/03. Very well; full control over bladder; passes urine every two hours day and night.

LIST OF CASES OF PROSTATECTOMY (*continued*)

No.	Name	Age	General Condition before Operation	Local Condition before Operation	History	Urine	Operation and Date	After-Progress and Results
13	W. H.	66	Good.	Frequent micturition—twenty times during night; not so much during day. Stream has no force. *Per rectum*—Prostate felt enlarged.	*Five years ago* in hospital; sounded for stone—none found, but urine contained albumen and blood then. Since then has had painful and frequent micturition—worse at times. He has never had to use a catheter.	*Residual*—2½ oz.	29/11/02. ***Suprapubic Prostatectomy.*** Prostate collar variety; unable to be enucleated; portion punched out from behind urethra. This freed obstruction. Pump drainage.	2/12/02. Pump removed. 20/1/03. All urine by penis. Suprapubic wound closed. *Readmitted* 9/3/03, with very bad cystitis, hæmaturia, and passage of small calculi, with great pain. 23/5/03. Wound reopened; *several phosphatic calculi removed from post-prostatic pouch.* 14/6/03. Still frequent micturition; no cystitis. Patient died after second suprapubic lithotomy.
14	C. S.	58	Good.	*Per rectum*—Prostate not much enlarged as felt per rectum. It is tender.	*Six months ago* retention of urine relieved by catheter. 'Catheter-life' ever since; passed once during night and every four hours during day. Never any blood in urine.	Sp. gr. 1030. Acid. No albumen. No blood. No pus.	3/12/02. ***Suprapubic Prostatectomy.*** Both lobes enucleated with finger; considerable post-prostatic pouch; no sacculation of bladder.	23/1/03. Slight pneumonia of left base of lung. ***Pelvic cellulitis developing*** on left side of pelvis. 27/1/03. Large abscess opened to left side of mid-point of perineum. 13/2/03. Rectal abscess nearly healed. Left hospital. *April* 1903. Quite well; no urinary symptoms whatever. *Jan.* 1904. Patient in perfect health.
15	H. G.	68	Feeble old man. Pulse 80, intermittent and low tension. Temperature 102°·6 F.	Absolute retention; bladder up to umbilicus. *Per rectum*—Thrombosed hæmorrhoids. Prostate very large and hard.	*May* 1897. *Double vasectomy* for enlarged prostate. Since then urinary trouble as before. Frequent micturition day and night. Often had to use catheter, and always found residual urine. Stream full, but no force. Gradually grew worse until retention of urine took place *two days before admission.*	Sp. gr. 1012. Alkaline. Large quantity of albumen. Blood and pus. *Urea*—8·5 gr. per oz.	18/2/03. *Perineal Prostatectomy.* Median perineal incision; urethra opened on staff; some pus from a cavity round prostatic urethra. Capsule incised; adenomata of both lobes easily enucleated with bridge connecting them. Drainage tube.	23/2/03. Never recovered from operation, and *died to-day.*

16	J. D.	65	Robust.	Slight incontinence of urine. *Per rectum*—Prostate much enlarged.	*Six weeks ago*, difficulty in passing water. *Two weeks ago* began to have incontinence of urine.	Sp. gr. 1012. Alkaline. No albumen. No sugar. No pus. *Residual*—22 oz.	16/6/03. *Suprapubic Prostatectomy.* Bladder opened. Left lobe of prostate projecting over internal urinary meatus. Prostate enucleated by finger. Urethra left intact.	14/8/03. Bronchitis; slow recovery; now quite well; no urinary symptoms. 10/3/04. Still quite well.
17	J. G. Specimen 49	60	Fair. Pulse 80. Temperature 99°·8 F. Tongue dry.	Absolute retention on admission. *Per rectum*—Prostate enlarged.	*Four years ago* noticed he had to get up three times during night to micturate. On several occasions he had *retention* relieved by catheter. For few days before admission all urine drawn off by catheter.	—	1/7/03. *Suprapubic Prostatectomy.* Prostate enucleated in two pieces. Bladder drained.	18/8/03. Left hospital quite well; wound healed. Has control over micturition. 1/2/03. Perfect control; gets up twice during night to pass water, and micturates every two hours during day. Urine clear and acid.
18	J. A.	64	Healthy.	No note.	*One year ago* only able to pass a little water by urethra. Unable to empty bladder. Frequent and painful micturition These symptoms have got worse.	Sp. gr. 1014. Acid. No sugar. No albumen. No pus.	9/9/03. *Suprapubic Prostatectomy* Prostate removed in one piece tunnelled by hole in centre by prostatic urethra.	22/10/03. Perfect control; rises every three hours during night; large stream; no straining.
19	J. B.	72	Thin and emaciated.	*Per rectum*—Prostate hard, not elastic, fixed.	—	—	17/7/03. *Suprapubic Partial Prostatectomy.* Prominent bulging to left of urethra. Canal tunnelled through prostate. *Adenomata not removed.*	*Microscope report.*—Adenoma of prostate.
	Readmitted 21/12/03		All urine escaping by suprapubic opening. Hard inflammatory mass round scar.	*Per rectum*—Prostate very hard and nodular—feels like unoperated-upon case.	—	Sp. gr. 1030. Acid. No albumen. No sugar.	19/2/04. Suprapubic opening dilated. Small adenoma shelled out with difficulty from left lobe. Considerable hæmorrhage. Pump drainage.	*Microscope report.*—Adeno-carcinoma of prostate. 10/3/04. Very well; suprapubic wound not quite healed. passing a good deal of urine per urethram.
20	T. M. H. Specimen 46	75	Feeble old man. Lips blue. Pulse feeble. Has irreducible *scrotal hernia and septic hydrocele.* On day of operation patient had a rigor.	No urine can be voluntarily passed. *Per rectum*—Prostate much enlarged on left side, which felt soft and boggy, as though it contained pus.	*Five years ago* commenced with frequency of micturition, worse at nights. *Four years ago* found he could not empty bladder; catheter used twice a day; bad attack of cystitis. *Three weeks ago* complete retention: great difficulty in passing catheter, which was tied in, and he has been confined to bed.	Sp. gr. 1020. Acid. Contains albumen. *Urea*, 8 gr. per oz.	10/9/03. *Suprapubic Prostatectomy.* Prostate much enlarged—all three lobes, especially left lateral. Adenomata shelled out without any trouble. Very collapsed after operation.	*Died* seven hours after operation; never recovered from shock. No necropsy.

LIST OF CASES OF PROSTATECTOMY (*continued*)

No.	Name	Age	General Condition before Operation	Local Condition before Operation.	History	Urine	Operation and Date	After-Progress and Results
21	W. H.	58	Good.	Slight frequency by day. Marked frequency by night. Stream has no force, and there is marked dribbling. Pain above pubes before micturition. *Per rectum*— Both lateral lobes of prostate enlarged; right side most prominent.	*Four months ago* pain over hypogastrium before micturition. Great frequency, especially at night. Urine often high-coloured.	No note.	13/9/02. *Suprapubic Prostatectomy.* Prostate could not be shelled out. Removed with great difficulty in three pieces. Pump drainage.	3/11/02. Pump removed. 15/11/02. Large abscesses opened on each side of scrotum. 24/11/02. All urine by penis; wound healed. 6/1/03. *Readmitted with impassable stricture urethræ.* All urine by suprapubic wound. *Operation* 17/1/03. Retrograde catheterisation and dilatation of stricture by bougies. 14/3/03. Wound healed. Taught to use bougie himself.
22	J. W. H. Specimen 36 Drawing 43	74	Fairly healthy.	*Per rectum*— Prostate much enlarged, right lobe especially.	*Seven years ago* trouble with urine: had instrument passed. Since then continuous 'catheter-life.'	Sp. gr. 1023. Acid. No albumen. No sugar.	21/10/03. *Suprapubic Prostatectomy.* Prostate enucleated without much difficulty. Drainage tube.	*Died*, night of operation, *from hæmorrhage.* *Necropsy.*—Blood extravasated round neck of bladder. Portion of prostate in front of urethra was still *in situ*. There was a large tear in capsule of prostate, invading the venous plexus, from which the hæmorrhage had arisen.
23	R. M.	68	Healthy old man.	Incontinence of urine night and day. Marked dribbling. Stream no force. *Per rectum*— Large prostate felt.	*Six months ago* commenced to have difficulty in making water. At other times it used to dribble away without patient's knowledge. This has persisted. Stream has no force and spreads out. Urine offensive odour, contains a sediment, and blood occasionally.	Urine alkaline. Sp. gr. 1015. No sugar. Contains blood and pus. *Residual*— 42 oz.	22/12/03. *Perineal Prostatectomy.* Median vertical incision carried round either side of anus. Prostate well exposed. Urethra opened and prostate pulled down with Sym's retractor. Adenomata shelled out of both lobes. Perineal drainage tube.	22/2/04. Quite well. Left hospital. 29/2/04. Quite well. No nocturnal micturition. Urine normal.

24	J. H., Specimen 56	75	Good.	*Per rectum*— Prostate enlarged. Consistency elastic	*On Christmas Eve*, 1903, retention of urine; great pain; catheter passed daily until *Jan*. 9, 1904, when he micturated himself, but had great frequency, every fifteen minutes, and this accompanied by a burning pain.	—	20/1/04. *Perineal Prostatectomy.* Median perineal incision prolonged back into ischiorectal fossa. Urethra opened on staff. Wheelhouse's gorget passed into bladder, followed by finger. Two adenomata easily shelled out—one from right and one from left lobe. Perineal drainage tube.	*March* 1904. Patient going on well.
25	M. M. Specimen 55	70	Good.	Complete retention of urine. Bladder very much distended. *Per rectum*— Enlarged prostate.	*Two years ago* illness commenced with difficulty and great frequency of micturition; if he did not at once obey calls to micturate the urine dribbled away. Had to get up three or four times during night to pass water. On day of admission, after 'drinking bout,' got complete retention of urine.	Sp. gr. 1010. Neutral. Contains albumen and blood.	5/6/03. *Suprapubic Enucleation.* Prostate projecting into bladder to right side of internal urinary meatus. Mucous membrane incised over projection. Two adenomata size of hen's eggs shelled out; prostatic urethra left intact. Drainage.	28/6/03. Passed a little urine per urethram for first time. 8/7/03. All urine by penis; suprapubic wound healed. Patient says he is as well as ever he was in his life. *Microscopical report of prostate.*—A few gland alveoli with colloid contents; much connective tissue and involuntary-muscle fibres.
26	C. W.	80	Good.	*Per rectum*— There is distinct enlargement of each lateral lobe of prostate. The left lobe is the larger, and projects to an unusual extent into rectum. There is a *stricture urethræ* which admits only No. 4 silver catheter. Another stricture 1″ from meatus.	Illness commenced *four years ago* with retention of urine relieved by catheter. Up to *six months ago* patient has had three attacks of retention, with intervening frequency and difficulty. *Six months ago* much worse, constant desire to micturate and only able to pass a few drops at a time. *During last few weeks* urine has been foul-smelling and has contained blood. Patient has used bougies for last *ten years* for *stricture urethræ*.	Sp. gr. 1016. Foul-smelling, pale, and cloudy. Acid. Swarming with long motile bacteria, a few pus cells. No sugar. Trace of albumen. *Urea*, 1·08 per cent. *Residual*, 9 oz.	13/1/03. *Perineal Prostatectomy.* Prostate well exposed; urethra opened and prostate pulled down by Sym's retractor. Both lobes incised and removed in pieces with volsella and fingers. Perineal drainage tube; incision partly sutured. *Stricture urethræ* had previously been dilated with Lister's bougies.	19/2/03. Went home. Good general condition. Perineal wound not quite healed, but he passes nearly all his urine per urethram. *Oct*. 1903. No urinary trouble. In perfect health.
27	R. C. Specimen 48	71	Good.	Bladder sounded. *Vesical calculus* struck. *Per rectum*— Prostate soft and moderately enlarged, not tender. Much straining and pain when passing urine, which he does *every ten minutes*.	In 1900 patient had a suprapubic cystotomy performed and projecting middle lobe of prostate removed. Since then he has been quite well until a *few weeks ago* when he had a severe attack of cystitis with frequent painful micturition, much mucus, and some blood.	—	17/4/03. *Suprapubic Lithotomy and Prostatectomy.* Bladder opened to right of former incision. *Soft phosphatic calculus removed.* Prostate projecting as two lateral masses into bladder; no trace of middle lobe. Two fingers could be passed into urethra. The catheter was found *to have passed through right lobe* and not to have kept to urethra. Adenoma shelled from each lobe separately.	26/4/03. Pump removed. 1/5/03. Passed ½ oz. urine per urethram. 9/5/03. Wound healed. 16/5/03. Left hospital very well. All urine by urethra. 4/6/03. Attack of cystitis at home. Bladder washed out with Bigelow's evacuator; phosphatic grit removed 11/6/03. Quite well; urine normal. *Dec*. 1903. Quite well; no urinary trouble.

LIST OF CASES OF PROSTATECTOMY (*continued*)

No.	Name	Age	General Condition before Operation	Local Condition before Operation	History	Urine	Operation and Date	After-Progress and Results
28	T. A.	80	Good.	Prostate is exceedingly hard as felt *per rectum*. It feels like a piece of wood projecting from behind pubes, and is fixed. A *vesical calculus* can be felt bimanually.	*Fifteen months ago* pain and frequency of micturition, every three hours. This continued for one month, and then he got retention, relieved by catheter; since then 'catheter-life.' Lately has had to pass catheter every two hours, and has greater frequency than ever, especially during day, with great pain at end of penis, and hæmaturia.	Sp. gr. 1020. Alkaline. Very foul-smelling, turbid, full of mucus, pus cells, and triple phosphates. Teeming with bacteria. Contains albumen.	5/11/02. *Litholopaxy.* Soft phosphatic calculus. Crushed with lithotrite and removed by evacuator.	14/11/02. Went home; uses catheter and washes out bladder every six hours.
	Readmitted, 29/12/02.			—	Perfectly comfortable for *six weeks* after leaving hospital; slept at nights for *nine hours*. During the day could go *five hours*, but still *always had to use catheter*. *Ten days ago* great pain before, while, and after passing catheter, which he had to use *every two hours night and day*, with great pain at glans penis.	Sp. gr. 1021. Alkaline. Albumen. *Much sugar.* Large quantity of mucus and pus. *Urea*, 1·5 per cent.	31/12/02. *Suprapubic Prostatectomy.* Prostate projecting into bladder; urethral opening in centre of mass. *Large post-prostatic pouch* containing débris of calculi. Two adenomata equal size (right and left lateral) removed by enucleation with finger. Pump drainage.	8/1/03. Pump removed. 25/1/03. Passed some 'grit' by urethra. 3/2/03. Went home, wound quite healed; urine is foul-smelling and contains a quantity of mucus, and sometimes pieces of 'grit.' *Readmitted* 23/2/03. Symptoms of stone in bladder. 24/2/03. Removal of phosphatic débris from bladder.
	Readmitted, 11/3/03.			—	Since last operation (24/2/03) has had several attacks of pain and one of *severe hæmorrhage* treated by washing out bladder with hot boric lotion.	—	12/3/03. *Litholopaxy.* Large amount of soft phosphatic material removed with a small lithotrite. The surface of the bladder felt very rough. After débris was removed it did not bleed.	16/3/03. Very much better since operation. Has slept as much as eight hours at a time. There has been no blood in urine. Went home to-day. *April* 1903. Very well; no urinary symptoms whatever
29	F. B. Specimen 47	72	Good. Patient weighed 18 stone 10 lb.	*Per rectum*— Prostate enlarged and very hard.	*For several years* increasing frequency of micturition. *For last five weeks* micturition every ten or twenty minutes. *Two days before admission* absolute retention relieved by catheter, which gave almost intolerable pain as it was introduced.	Sp. gr. 1015. Acid. No albumen. *Urea*— Percentage very low.	8/9/03. *Suprapubic Prostatectomy.* Adenomata enucleated from all three lobes with difficulty; prostate very dense and fibrotic. Pump drainage.	20/9/03. Pump removed. 13/10/03. Passed urine per urethram voluntarily for first time since operation. 4/11/03. Very well. Wound healed. All urine passing per urethram. Left hospital. *Feb.* 1904. Quite well.

30	J. W. Specimens 53 and 35 Drawing 42	70	Exceedingly ill. Temperature 100°·6 F. Great pain.	Complete retention of urine and very bad cystitis.	*For seven years* has had to use a catheter himself. *For last few months* his brother has had to use catheter for him. He developed a very bad cystitis.	Putrid, and containing a large quantity of blood.	15/9/03. *Suprapubic Prostatectomy.* Very large prostate found. Both lateral lobes big. Adenomata shelled out in pieces from each lobe. Suprapubic drain.	*Death nine hours after operation from shock.* *Necropsy.* — Bladder sacculated and inflamed. In the bed from which prostate had been enucleated there remained a small adenoma on left side. *Microscopical report of Kidney.*—Evidences of interstitial nephritis.
31	T. B., Specimen 58	56	Excellent.	*Per rectum*— With sound in urethra a tumour about base of bladder could be made out.	No symptoms until sudden retention occurred without warning two days before admission.	Normal.	Operation in 1896. *Suprapubic Prostatectomy.* Middle lobe removed by cutting-forceps.	*Twelve months after operation* patient returned with sudden hæmorrhage from bladder. *Two years after operation* another similar attack of hæmorrhage. *Jan.* 1904. Perfectly well.
33	G. A. S. Specimen 54	68	Good.	*Per rectum*— Enlarged prostate distinctly bilobed.	*For several years* increased frequency of micturition at night. Had been in the habit of catheterising himself regularly. Recently developed cystitis.	—	22/4/03. *Suprapubic Prostatectomy.* Bladder opened. Two adenomata removed. Vesical calculus size of a pigeon's egg in a saccule removed. Pump drainage.	Patient went home *four weeks after operation* with relief of all symptoms. *Six months later* he developed cystitis, with septic nephritis, from which he *died.*
35	J. H. F. Specimen 32	67	Looks ill, with puffy eyelids.	*Bladder* full and reached up to umbilicus. *Prostate* enlarged and felt rather soft. *Catheter* — No. 12 rubber entered bladder with much difficulty.	*Six months ago* commenced with great frequency of urination, most marked during night, having to pass water every hour. On day of admission he got *retention of urine.*	Sp. gr. 1009. Acid. Contains albumen. No sugar.	None.	*Death two weeks after admission from uræmia.* *Necropsy.* — Specimen 32 removed. Enlarged prostate, sacculated inflamed bladder, dilated ureters and pelves of kidneys. Kidney, acute septic nephritis. *Microscopical report on Prostate.*—Adenoma of prostate, consisting chiefly of closely packed glandular tubules. In many of them typical amyloid bodies are seen.
36	A. P. Specimen 37	76	Blind man. Wholly unable to obtain assistance in catheterism. Very poor condition.	Complete retention. Three pints of urine drawn off by catheter without difficulty.	*Two months ago* symptoms commenced. *One week ago* passed catheter for first time. Large amount (40 oz.) of residual urine. Micturition every half-hour, night and day, previous to this.	Sp. gr. 1015. Limpid. Full of sugar. No albumen.	8/2/04. *Suprapubic Prostatectomy.* Three little adenomata enucleated from prostatic urethra. The prostate extremely hard and not greatly enlarged.	*Death* eight days after operation. Patient went on well for five days and then became uræmic and died.

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